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A pan-European delimitation of coastal waters

Compliance with EU environmental legislation

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LIST OF ACRONYMS

AL	Albania
BA	Bosnia and Herzegovina
BE	Belgium
BG	Bulgaria
BR	Brazil
CIRCA	Communication Information Resource Centre Administrator
CY	Cyprus
DE	Germany
DK	Denmark
EE	Estonia
EEZ	Exclusive Economic Zone
EG	Egypt
ES	Spain
ETRS	European Terrestrial Reference System
EU	European Union
FI	Finland
FR	France
GB	United Kingdom
GE	Georgia
GIS	Geographic Information Systems
GR	Greece
GSHHS	Global Self-consistent, Hierarchical, High-resolution Shoreline
HR	Croatia
ICZM	Integrated Coastal Zone Management Recommendation
IE	Ireland
IMP	Integrated Maritime Policy
IS	Iceland
IT	Italy
JRC	Joint Research Centre
LT	Lithuania
LV	Latvia
LY	Libyan Arab Jamahiriya
MA	Morocco
MC	Monaco
ME	Montenegro
MK	Macedonia
MSFD	Marine Strategy Framework Directive
MT	Malta
MU	Mauritius
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SR	Suriname
TR	Turkey
UA	Ukraine
UNCLOS	United Nations Convention on the Law Of the Sea
VLIZ	Flanders Marine Institute
WDBII	World Data Bank II
WFD	Water Framework Directive
WGS	World Geodetic System
WISE	Water Information System for Europe
WVS	World Vector Shoreline

SUMMARY

The definition of coastal waters in relation to EU environmental legislation was clearly stated in the Water Framework Directive. In compliance with this Directive, most of the EU Member States delineated their coastal waters' boundaries. However, these delineations are not as complete and homogeneous as could be expected. A clear identification of European coastal waters boundaries is crucial for the implementation of the Water Framework Directive and the Marine Strategy Framework Directive, which depend on an accurate ecological/environmental assessment of those waters. Hence, there is a need for a comprehensive and unambiguous delimitation of European coastal waters.

This report aims at bridging this gap providing a pan-European mapping of coastal waters, which cover 553,817 km^2 in 30 seaside countries, 340,524 km^2 of which pertain to the 22 EU Member States connected to the sea. For this purpose, a comprehensive geographical analysis of the national baselines and transitional waters distribution was performed. A pan-European baseline of 63,340 km was delineated as a basis for the European coastal waters delimitation.

The European coastal waters identified in this work show significant differences with the available national declarations (almost 12% of the compared area), the latter defining an additional area of 29,337 km^2 with respect to the former. The largest deviations seem to be due to misinterpretations of the definition of coastal waters in the Water Framework Directive, although a number of one-sided national modifications to that definition are also observed. This work provides the geographical basis for a full consultation process and discussion about this subject.

Our recommendations include setting a clear geographical limit between the Water Framework Directive and the Marine Strategy Framework Directive jurisdiction, revise the possible exemptions in the definition of coastal waters, and discuss their consequences in the assessment of ecological/environmental status.

INTRODUCTION

The EU legislation related to an ecosystem-based management of freshwater and marine environments uses maritime administrative boundaries (in particular, baselines) to set the limits of certain natural zones like coastal waters. Thus, coastal waters are defined in Art. 2 of the Water Framework Directive (WFD; Directive 2000/60/EC) as "surface waters on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters".

Two main issues arise from this definition of coastal waters:

1. The definition of maritime administrative boundaries such as "the baseline from which the breadth of territorial waters is measured", seen as territorial claims and national sovereignty designations, is a very delicate and controversial issue (e.g. Ashley Roach and Smith, 2000; Noussia, 2010). Therefore, the position of the baseline is not always defined and internationally agreed.

2. To date, the definition of transitional waters is not clear at the European level (e.g. McLusky and Elliott, 2007).

Coastal waters have been designated by the EU Member States and Norway following Art. 3 of the WFD. However, the analysis of such designations yields several gaps and geographical inconsistencies in national definitions and with respect to EU regulations. The ambiguity of those definitions may have a large impact on the ecological assessment under the WFD since the monitored environmental parameters may have a large variation (both in value and type) depending on the area in which they are being measured. Thus, this ambiguity hampers the scientific research that is being deployed to support the implementation of EU environmental legislation.

The purpose of this work is to provide a clear and objective delimitation of the European coastal waters which will facilitate the development of comparable scientific studies and correct ecological assessments. These studies are crucial in the support to the implementation of various EU policy instruments, such as the abovementioned WFD, the Marine Strategy Framework Directive (MSFD; Directive 2008/56/EC), the Integrated Maritime Policy (IMP; European Commission, 2007), or the Integrated Coastal Zone Management Recommendation (ICZM; European Parliament and Council, 2002). It is out of the scope of this work to support any nation in possible existing international conflicts related to baseline positioning, as well as to question the national territorial declarations.

This report analyses the definition of coastal waters of the 22 maritime EU Member States (including the Community territories but not the associated Overseas Countries and Territories[1]), 3 candidate countries (Turkey, Croatia and Iceland), and other 5 European countries (Albania, Montenegro, Bosnia and Herzegovina, Monaco and Norway excluding

[1] The Community territory is the European Union, where the EU law applies. The Overseas Countries and Territories depend constitutionally on one EU Member State but the Community law does not apply directly to them (they have a special associate status).

its dependencies near/in Antarctica) (fig. 1). With this work we aim at attaining a pan-European delimitation of coastal waters, as well as comparing the results obtained with previous available definitions both at national and international levels. Hence, a new delimitation of European coastal waters is proposed as the basis for a future common and agreed demarcation of coastal waters with respect to the application of European directives related to water and environment.

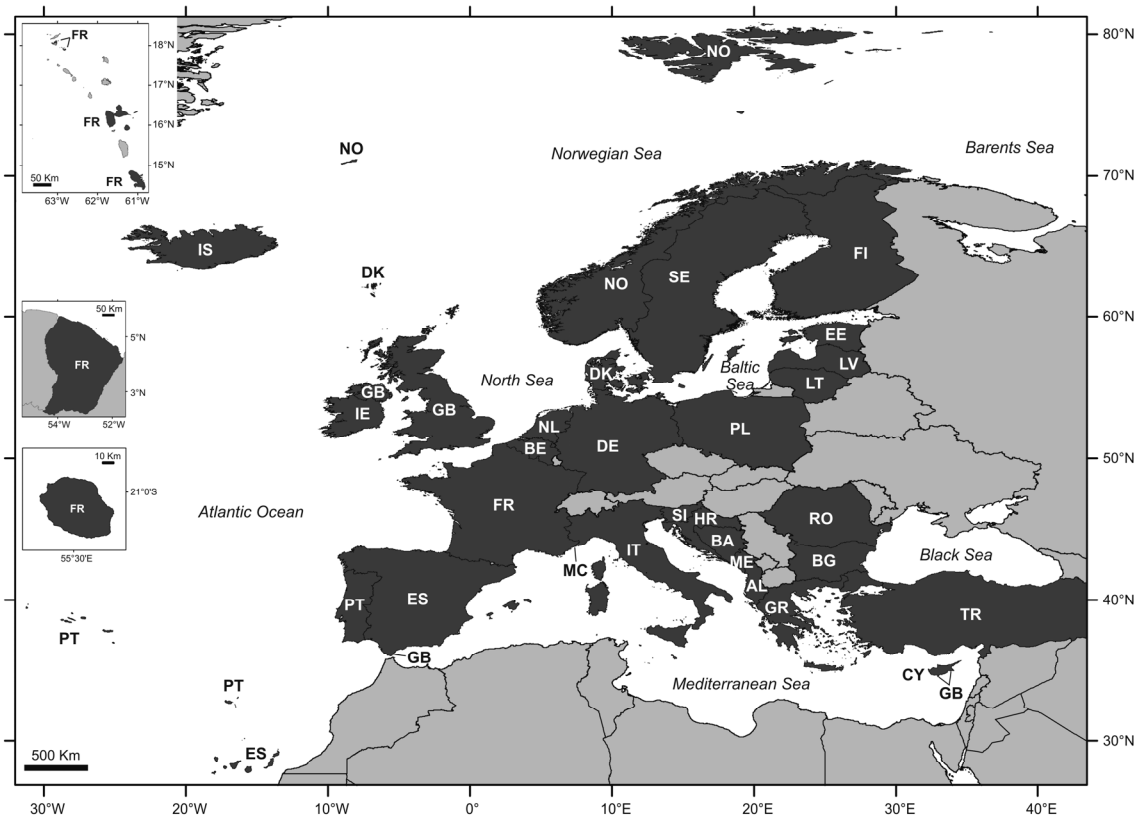

Figure 1. Location of the studied countries (in dark grey). Geographic coordinate system with datum WGS 1984.

METHODOLOGICAL APPROACH

Input data

As a first step toward a pan European assessment of coastal waters for the WFD and the MSFD, available geographical datasets related to maritime administrative boundaries and coastal waters delimitations were compiled into a geodatabase. The main data sources used in this research were:

a. The deposits of the United Nations Convention on the Law Of the Sea (UNCLOS) (Division for Ocean Affairs and the Law of the Sea, 2009). The information includes national legislation, treaties on the delimitation of maritime boundaries and other relevant information. Data extracted comprise regulations, charts and lists of geographical coordinates of points in relation to baselines definition. In particular, the

UNCLOS database was used (i) to delineate the baseline of certain European countries (specifically Iceland, Norway, Lithuania, Netherlands, Belgium, Portugal, part of Spain, Monaco, Malta, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Greece, Turkey and the French overseas departments), and (ii) to complete/update the baseline definition of the rest of studied countries, formerly extracted from the Eurosion Maritime Boundaries layer (see below).

b. The Water Information System for Europe (WISE) River Basin Districts geodatabase (European Environmental Agency, 2008). River Basin Districts are defined within the WFD as "the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters". The River Basin Districts were delineated by Member States under Art. 3 of the WFD and their reports are available through the Eionet Central Data Repository (http://cdr.eionet.europa.eu/). Data used in this research included:

   – River Basin Districts version 1.3 (including data from 2004-2008). Their marine border should be the external coastal waters' limit.

   – Transitional Waters version 1.0 (with data from 2005-2006).

   – Coastal Waters version 0.1 (with data from 2004-2007), noted to be preliminary. Sometimes specific information on coastal waters has not been provided but the marine border of the River Basin Districts can be used as an alternative.

c. The Global Self-consistent, Hierarchical, High-resolution Shoreline (GSHHS) Database version 2.0 (Wessel and Smith, 1996) updated in 2009. This global coastline is based on two databases, the World Vector Shoreline (WVS) and the World Data Bank II (WDBII). The shorelines are constructed entirely from hierarchically arranged closed polygons and are free of internal inconsistencies. In particular, all level-1 polygons (corresponding to ocean-land boundaries) are derived from the WVS while all higher level polygons (representing lakes) are taken from WDBII. The original source of data of the WVS was the United States Defense Mapping Agency.

d. The Maritime Boundaries layer generated by the Eurosion project in 2002-2004 (Directorate-General for Environment, 2005), which proposes a graphical view of the UNCLOS agreed maritime delimitations based on a compilation of national and international declarations since 1931. In the present study, some sections of the territorial baseline of 15 countries have been extracted from the Eurosion database (see more details in the Baseline positioning section).

e. The Maritime Boundaries geodatabase of the Flanders Marine Institute (VLIZ, 2009), in particular the GIS layer representing the Exclusive Economic Zone (EEZ) of the world countries. Note that VLIZ suggests using this dataset for scientific, educational or research purposes, but not for legal, commercial or navigational purposes.

f. The Corine (COoRdination of INformation on the Environment) Land Cover map version 13 (European Environmental Agency, 2010), the temporal coverage of which is the year 2000. This map allowed identifying some types of transitional water bodies,

namely salt marshes, intertidal flats, coastal lagoons and estuaries. These data were used together with the WISE Transitional Waters database. The Corine programme provides also a very high resolution coastline (Iglesias-Campos et al., 2006; The European Topic Centre on Land Use and Spatial Information, 2006) noted to have a geographic accuracy of 100 m and to be used only for non commercial purposes. This coastline has been analysed and finally disregarded for the purpose of this research.

As a general comment on the databases constituting the backbone of this exercise, it must be emphasized that results could be enriched by the availability of a very high resolution coastline database allowing, for instance, differentiating ports and coastal infrastructures. The Corine Land Cover 2000 coastline (Iglesias-Campos et al., 2006; The European Topic Centre on Land Use and Spatial Information, 2006) would be an ideal basis for the work described here. However, this database defines coastal lagoons as inland waters, and estuaries and tidal flats as marine water bodies (e.g. as far as 155 km inland in the case of the Scheldt River), a fact that makes it unsuitable for the delimitation of baselines and coastal waters following the WFD definition. In addition, the Corine coastline does not map hundreds of small islands that are crucial for this study (most probably because their extension is lower than the smallest mapping unit - 25 ha), and does not provide global or even pan-European coverage of the coastline. Therefore, the GSHHS database was chosen as the best option for a coastal analysis at the continental scale.

Processing

Hereinafter, the "baseline from which the breadth of territorial waters is measured" will be simply denoted as the *baseline* and the line "every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline" will be designated as the *1 nm line*.

In this work, compilation, comparisons and calculations were performed using the Esri ArcInfo 9.3 software (Copyright ©1999-2009 Esri Inc., http://www.esri.com). The steps followed to develop a new demarcation of European coastal waters after the WFD definition were:

A. Create an appropriate continuous European baseline (see details in the next section). The baseline was derived from geographic information extracted from the UNCLOS database, the GSHHS coastline definition and the Eurosion layer. In case of conflicting delineations, the information extracted from the UNCLOS database prevails. Internal errors like self intersections or gaps were checked and properly solved.

B. Delimit the buffer zone extending 1 nm on the seaward side of the baseline.

C. Demarcate the area between the baseline and the coastline. Again, internal errors and inconsistencies were properly resolved.

D. Define the first version of European coastal waters joining the results of steps B and C.

E. Compare the first version of European coastal waters with the available definitions of transitional waters in order to include possible bodies of transitional waters that may fall offshore (see details in the Transitional waters section).

F. Assign coastal waters to the individual countries by overlaying the former with the VLIZ EEZ layer. A small correction in the VLIZ EEZ layer was performed in the eastern part of the island of Samos, where the Greek EEZ cut the Anatolian Peninsula. There, a medium line between the peninsula and the island was followed. Finally, we obtained a shapefile with the European coastal waters divided by sovereignty.

The following sub-sections try to respond to the two main problems that arise from the interpretation of the WFD coastal waters definition (see Introduction), namely the uncertainty in the location of baselines and of transitional waters.

Baseline positioning

The repository of the Secretary-General of the United Nations pursuant to the UNCLOS is considered as the largest global compendium of national baseline definitions. In general, in the cases where the baseline is not specifically prescribed by regulation, it is to follow the low-water line along the coast which, in this work, is assumed to follow the GSHHS coastline. Otherwise, the baseline can follow straight lines joining discrete points on the low-water line defined by the corresponding nation. The straight lines are used in indented coastlines, to enclose a group of islands, or to close entrance points of bays or rivers.

In 15 of the studied countries (Sweden, Finland, Estonia, Latvia, Poland, Germany, Denmark, France, United Kingdom, Ireland, part of Spain, Italy, Cyprus, Bulgaria and Romania) the straight lines making up part of their baselines were extracted from the Eurosion Maritime Boundaries layer and checked against the UNCLOS repository. The original sources of information of the Eurosion database are listed in annex 2. The straight lines extracted from the Eurosion database were completed with GSHHS shoreline data to obtain a continuous baseline (fig. 2).

However, in a number of cases a new delineation of baselines was required. These cases are listed in table 1, along with the sources of information and some comments about data formats. Again, the GSHHS shoreline complements the straight lines and closures defined by national laws (fig. 2).

In the French Caribbean (Saint-Martin, Guadeloupe, Martinique and French Guiana departments), inaccuracies between the GSHHS coastline and the coordinates provided by the official baseline declarations (table 1) led to the use of national coastline delimitations (in particular, the River Basin Districts limits included in the WISE geodatabase) instead of GSHHS data.

Altogether, 37,271 km of the proposed European baseline were derived from the GSHHS coastline, 15,953 km were extracted from the Eurosion Maritime Boundaries layer, and 10,116 km were newly delineated (see table 1 and fig. 2). In no case can this baseline be seen as a definition in the legal or economic context.

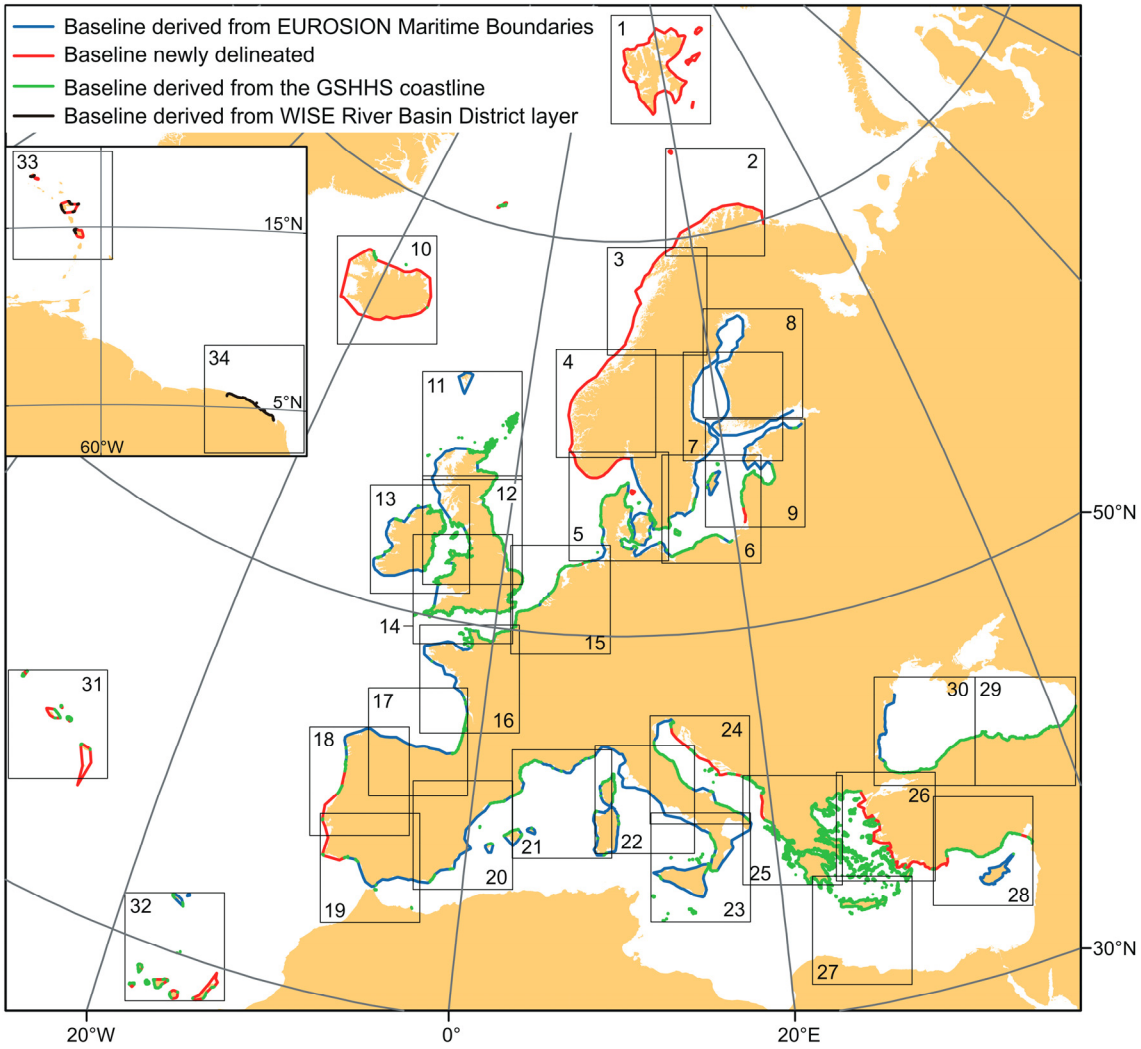

Figure 2. European baseline delineation and origin. Numbered boxes correspond to the location of maps in Annex 1. Map projection is Lambert Azimuthal Equal Area datum ETRS 1989 (main figure) and Albers Conical Equal Area datum South American 1969 (inset).

Transitional waters

EU Member States identified and defined their transitional water bodies following Art. 3 of the WFD. Some of their reports are available through the CIRCA public library at http://circa.europa.eu/Public/irc/env/wfd/library. The geographical information about the European transitional waters is included in the WISE Transitional Waters v.1.0 geodatabase (see Input data). However, there is also an outstanding scientific tool developed within the Corine programme of the European Commission that classifies several transitional water bodies (see Input data).

Country or region	Law defining the baseline	Available information
Iceland	Law No. 41 of 1 June 1979 concerning the Territorial Sea, the Economic Zone and the Continental Shelf	Coordinates of points determining the baseline
Norway	Royal Decree of 14 June 2002 for mainland Norway; Royal Decree of 1 June 2001 for Svalbard; and Royal Decree of 30 August 2002 for Jan Mayen	Coordinates of points determining the baseline
Lithuania	Maritime Zone Notification of 7 April 2006 referring to the Resolution No. 1597 of 6 December 2004 on the Approval of the Limits of the Territorial Sea, Contiguous Zone, Exclusive Economic Zone and Continental Shelf of the Republic of Lithuania	Coordinates of points determining the baseline
Netherlands	Netherlands Territorial Sea (Demarcation) Act of 9 January 1985	Coordinates or description of points (e.g. lighthouses) determining some straight lines and closures
Belgium	Act establishing the breadth of the territorial sea of Belgium, 6 October 1987	The baseline is defined as the coastal low-water mark, or permanent harbour works extending beyond that mark. For the purpose of this study, it is assumed to follow the GSHHS shoreline
Portugal	Decree-Law No. 495/85 of 29 November 1985	Coordinates of points determining the straight sectors of the baseline
Canary Islands (ES)	Royal Decree No. 2510/1977 of 5 August 1977	Coordinates of points determining the straight sectors of the baseline
Monaco	Sovereign Ordinance No. 5094 of 14 February 1973	The baseline is defined as the low-water line along the coast
Malta	Territorial Waters and Contiguous Zone Act, No. XXXII of 1971, as amended by Acts XLVI of 1975, XXIV of 1978, XXVIII of 1981 and I of 2002	The baseline should follow "the coast of Malta measured from low-water mark on the method of straight baselines joining appropriate points". Since those points are not defined, the baseline is assumed to follow the shoreline for the purpose of this study
Slovenia	Slovenian Maritime Code, 2001 (Art. 5)	The definition of internal waters is very general (e.g. "all ports, bays…"). For the purpose of this study the baseline is assumed to follow the GSHHS shoreline
Croatia	Maritime Code, 1994 (Art. 19)	Text description of the geographic features determining three straight sectors of the baseline
Bosnia and Herzegovina	No charts or lists of coordinates are available in the UNCLOS repository	The baseline is assumed to follow the shoreline for the purpose of this study
Montenegro	No charts or lists of coordinates are available in the UNCLOS repository	The baseline is assumed to follow the shoreline for the purpose of this study

Albania	Decree No. 4650, amended by Decree No. 7366, of 9 March 1990, on the State Border of the People's Socialist Republic of Albania	Text description of the geographic features determining a straight baseline
Greece	Law No. 230 of 17 September 1936	The baseline is defined as the coastline
Turkey	Law No. 476 from 1964 (not included in the UNCLOS repository)	No coordinates or text descriptions, only a small-scale chart ("Türkiye, Karasulari esas ve Düz Hatlari Haritasi, 8003") from which the baseline has been digitised
Saint-Martin, Guadeloupe, Martinique (FR)	Decree 99-324 of 21 April 1999	Coordinates of points determining the straight sectors of the baselines
French Guiana, Reunion (FR)	No charts or lists of coordinates are available in the UNCLOS repository	The baseline is assumed to follow the shoreline for the purpose of this study

Table 1. Sources of information for the newly delineated sections of the European baseline built in this work (see the geographical representation in figure 2).

	After the national declaration	After the Corine Land Cover map
Lithuania	The plume of the Curonian Lagoon in the Baltic Sea	
Poland	Minor zone offshore the Szczecin Lagoon	
Denmark		Several sectors around the Laeso Island
Germany		Minor zones offshore the Amrum and Borkum islands
United Kingdom	Several sectors offshore the Cree, Ribble and Dee estuaries, in the Colwyn Bay and in the Thames and Swale estuaries	Minor zones offshore Barrow-in-Furness, the Dee Estuary, offshore Bangor, around the Thames Estuary, in Firth of Tay and in the Strangford Lough (N Ireland)
Ireland	Minor zones in the Foyle Lough, Dublin Bay, and Slaney Estuary. Part of the Inner Dundalk Bay.	Part of the Inner Dundalk Bay
France	Several sectors offshore the Port of Dunkerque and the Rhone Delta	Scatter zones all along the Atlantic coast, especially linked to river mouths
Spain	Minor zone off the Tinto-Odiel estuary	
Turkey		Minor zone in the western Yesilirmak Delta in the Black Sea

Table 2. Location of transitional waters extending beyond the European 1 nm line delineated in this work either after the official national declaration (pursuant to the WFD and included in the WISE Transitional Waters v.1.0 database) or after the Corine Land Cover map v.13 (in particular the land cover classes: salt marsh, intertidal flat, coastal lagoon and estuary).

The definition of coastal waters from the WFD includes those transitional waters that extend seaward beyond the European 1 nm line. Identification and delineation of such waters for this study required: (i) compiling all the transitional water bodies included in the WISE Transitional Waters v.1.0 database together with the land cover classes 421, 423, 521 and 522 (corresponding to salt marsh, intertidal flat, coastal lagoon and estuary) of the Corine Land Cover map v.13; (ii) overlapping these transitional water bodies with the first version of European coastal waters; (iii) identifying the part of the transitional waters laying on the seaward side of the 1 nm line (i.e. offshore the first version of European coastal waters); and (iv) merging those parts with the coastal waters. Table 2 describes where the coastal waters were enlarged to comprise the transitional waters, and what the source of their original definition was.

Overall, 628 km^2 of transitional waters spreading beyond the 1 nm line have been added to the European coastal waters definition. However, it could lack a large fraction of eutrophic plumes which are not properly delimited at present (Ferreira et al., 2010).

RESULTS

The present work has set up the limits of the European coastal waters in compliance with the WFD definition. The resulting coastal waters polygon and baseline polyline shapefiles will be publicly available through a JRC website soon. Meanwhile, they can be requested to the authors.

The estimated coastal area of each European country is shown in table 3. Altogether, the European coastal waters occupy 553,817 km^2, 340,524 km^2 of which correspond to the coastal waters of EU Member States. This area is smaller than the rough estimation of 405,703 km^2 by Borja (2005).

After these results, Norway has the largest extension of coastal waters while Monaco has the largest proportion of coastal waters related to its territory. Related only to EU Member States, the United Kingdom coastal waters are the most extensive ones, whereas Maltese coastal waters represent the largest national fraction.

A detailed comparison of the previous and the newly-developed geographical datasets allowed identifying the main deviations between the European coastal waters proposed in this paper and the national declarations pursuant to the WFD. In the case of Svalbard, Jan Mayen, Iceland, Faroe Islands, Italy, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Turkey, Bulgaria and Romania no previous national declaration of coastal waters is available, so no comparison is possible with the results obtained in this work. For the rest of Europe, table 4 and annex 1 show the comparative geographical analysis.

In certain countries (e.g. France, United Kingdom) we noticed a number of divergences between our delimitation of coastal waters and the national declarations specifically sited near river mouths. This suggests that certain national governments must have more updated (and probably more accurate) delimitations of transitional waters than the ones used for this study.

Sovereign	ISO Code	Area (km²)	Rank. (km²)	Area (%)	Rank. (%)
Albania	AL	1399	21	5	18
Bosnia and Herzegovina	BA	13	29	0.03	30
Belgium	BE	126	27	0.4	28
Bulgaria	BG	1278	22	1	25
Cyprus	CY	1536	20	17	13
Germany	DE	10867	16	3	21
Denmark[1]	DK	19581	12	45	3
Estonia	EE	14482	13	32	6
Spain[2]	ES	22906	10	5	19
Finland	FI	31797	6	9	16
France	FR	21153	8	4	15
France (overseas Departments[3])	FR	5155		6	
United Kingdom[4]	GB	56064	2	23	8
Greece	GR	24035	9	18	12
Croatia	HR	13586	14	24	7
Ireland	IE	13350	15	19	10
Iceland	IS	37517	4	36	5
Italy	IT	55316	3	18	11
Lithuania	LT	974	23	1	23
Latvia	LV	960	24	1	24
Monaco	MC	8	30	382	1
Montenegro	ME	305	25	2	22
Malta	MT	265	26	83	2
Netherlands	NL	4465	17	11	14
Norway[5]	NO	130688	1	40	4
Poland	PL	2753	18	1	26
Portugal	PT	19779	11	21	9
Romania	RO	1813	19	1	27
Sweden	SE	31811	5	7	17
Slovenia	SI	56	28	0.3	29
Turkey	TR	29779	7	4	20

Table 3. Estimated area covered by coastal waters in the European countries and ranking of those countries both in absolute terms (km²) and relative to the country area (%). Grey shading indicates non-EU Member States. [1]Including Bornholm and Faroe Islands. [2]Including Ceuta and Melilla. [3]Saint-Martin, Guadeloupe, Martinique, French Guiana and Reunion. [4]Including Isle of Man, Guernsey, Jersey, Gibraltar and the GB sovereign base areas in Cyprus. [5]Including Svalbard and Jan Mayen.

DISCUSSION

Geographical analysis

The analysis of the available public georeferenced information related to coastal waters reveals the following discrepancies in EU coastal waters definition (see table 4 and annex 1):

- Some Member States did not declare the geographical limits of their coastal water bodies in time (pursuant to the WFD) and therefore are not included in the WISE geodatabases (e.g. Italy).

- Some Member States included their coastal waters in their River Basin Districts delimitations but do not have a separate coastal waters definition, at least in the WISE geodatabases (e.g. Sweden).

- The offshore delimitation of River Basin Districts by some Member States is not consistent with their own coastal waters definition (e.g. Estonia).

- Some countries have misinterpreted the definitions of the WFD and have extended their coastal water up to the limit of territorial waters (e.g. Belgium). This is probably due to the fact that the WFD foresees the good chemical status of surface waters included in the territorial sea (defined as that extending up to 12 nm from the baseline), while it foresees the good ecological status of coastal waters (as far as 1 nm from the baseline).

- Frequently, the national delimitation of coastal waters does not follow the WFD definition (e.g. United Kingdom).

- The declaration of transitional waters seems incomplete when compiling all the available data (e.g. Greece, where there are no officially declared transitional water bodies).

Country	Main deviations
Norway	In the area of point NM49 of the Norwegian baseline there is an enlargement of the coastal area of up to 3.5 km with respect to the results of this work; between points NM82 and NM83 as well as between NM97 and NM98 the coastal area is shortened; close to the Swedish border there is an enlargement of up to 5 km.
Sweden	Around the southernmost county of Skåne the national definition follows the territorial sea limit instead of a coastal definition. There are also unexpected closures of bays in the southern area and some differences around the Öland and Gotland islands. Two deviations of up to 6 km seaward have been noted in front of the Aland Islands and in front of the Kvarken Archipelago.
Finland, Lithuania, Monaco, Cyprus	There is a reasonable overlap between the national and the present work delimitations. In Finland there are some differences around a few small islands due to disparities in the coastline definition.
Ireland	Coastal waters after the national definition are enlarged in the Dundalk and Dublin bays.
Estonia	The coastal area after the national declaration is shortened near Kohtla-Järve with respect to the results of this work. The outer limit of the River Basin Districts is placed further offshore than the national limit of coastal waters.
Latvia	There is an unexpected closure of bays along the Gulf of Riga after the national definition that causes enlargements of up to 12 km.
Poland	Coastal waters after the national definition seem to be enlarged (around 7 km) in the Russian border and shortened (up to 5 km) in the Gulf of Gdańsk.
Germany, Belgium	The national definition follows the territorial sea limit instead of defining the coastal waters. In the German case, there is a subdivision of coastal waters within the territorial sea that differs systematically from the results of this research.
Denmark	The national delimitation goes far beyond the limits estimated in this work around the Laeso and Anholt islands, western Kattegat, southern Skagerrak and in the western and south-eastern coast of the Syddanmark region. Due to the definition of GSHHS coastline, this work does not include the Lim and Ringkobing fjords as coastal waters.

Netherlands	The national definition of River Basin Districts disagrees with the declared coastal waters. Deviations in the coastal area have been found around the Dutch Frisian Islands and in the southernmost Zeeland province. A punctual correction had to be performed in the GSHHS coastline in order to exclude the large Ijsselmeer and Markermeer from coastal waters, since they are considered as internal waters by the Dutch government.
United Kingdom	An area of 3 nm from the baseline, instead of the expected 1 nm, is considered as coastal waters around Scotland, Rockall, the Orkney and the Shetland islands. No coastal area was officially defined in the Isle of Man, the Guernsey and the Jersey islands, Gibraltar, or the GB sovereign base areas in Cyprus. Systematic enlargements of the coastal waters are noticed in most of the bays and estuaries along the rest of Great Britain and Northern Ireland, except in the Bristol Channel where the national definition shortens the coastal area by up to 55 km.
France	Numerous deviations are observed along the French Atlantic coast, either enlarging or shortening the coastal waters. It seems that the baseline used in this study and the one used for the national definition is different.
Spain	A few deviations are noticed in northern Lanzarote (Canary Islands), around Gibraltar, eastern Almeria, and in Mar Menor. Ceuta and Melilla and some small islands were not included in the national declaration.
Portugal	In the southeastern coast, the baseline used in this work follows straight lines while the national definition seems to follow the shoreline. In the Azores Archipelago, there are noticeable shortenings of coastal waters around Pico and southward Santa Maria.
Malta	The national definition fits fairly well with the results of this research with the exception of the Filfla Islet, which is not included in the national declaration.
Slovenia	The officially declared coastal area is markedly larger than the estimate of this work, even exceeding the Slovenian EEZ.
Greece	In general, the national declaration agrees with the results of this study except for some small islands that differ in the coastline definition. Some deviations are noted in the Amvrakikos and the Maliakos gulfs, near Thessaloniki, and in the Lesbos Island where the national definition includes large semi-closed areas. After the available data, no transitional waters were declared in Greece.
French overseas departments	No coastal waters were explicitly defined. However, the offshore limit of the River Basin Districts matches the coastline in all the cases. This is visibly tighter than the baseline definition of the Saint-Martin, Guadeloupe and Martinique departments, while it agrees with the supposed baseline of French Guiana and Reunion.

Table 4. Main geographical differences between the European coastal waters proposed in this work and previous national declarations.

The difference in area between the European coastal waters as delimited in this work and the available national declarations is shown in table 5. In 15 countries the area defined by national declarations exceeds the one determined in this study, whereas in 5 countries the extension of declared coastal waters is lesser than expected, mostly due to the lack of inclusion of certain islands (see table 5). Official coastal water declarations (excluding the River Basin Districts information) exceed the estimate of this research by 29,337 km^2 (i.e. nearly 12% of the compared area). The largest deviations (Belgium, Slovenia and Germany) seem to be due to misinterpretations in the definition of coastal waters by the WFD. The reasons for the different delimitation of coastal waters observed in countries like Latvia, United Kingdom or France are more difficult to evaluate. The relevance of such differences for the implementation of EU environmental directives is discussed in the next section.

Sovereign	ISO Code	Difference (km^2)	Difference (%)	Main explanation
Belgium	BE	1337	1059	Inclusion of the whole Territorial Sea
Bulgaria	BG	*N.D.*	*N.D.*	
Cyprus	CY	252	16	Inclusion of the GB sovereign base areas
Germany	DE	12786	118	Inclusion of the whole Territorial Sea
Denmark	DK	610	3	
Estonia	EE	101	1	
Estonia[1]	EE[1]	10601	73	
Spain	ES	-195	-1	Exclusion of the Mar Menor, Ceuta, Melilla and small islands
Finland	FI	1915	6	
France	FR	1765	8	
France (overseas Departments)	FR	*N.D.*	*N.D.*	
United Kingdom	GB	10831	19	Systematic enlargements
Greece	GR	365	2	
Ireland	IE	525	4	
Italy	IT	*N.D.*	*N.D.*	
Lithuania	LT	-18	-2	
Latvia	LV	516	54	Closure of bays along the Gulf of Riga
Malta	MT	-11	-4	Exclusion of the Filfla Islet
Netherlands	NL	94	2	
Norway[1]	NO[1]	-39994	-31	Exclusion of Svalbard and Jan Mayen
Poland	PL	2	0	
Portugal	PT	-1836	-9	Exclusion of Sao Gonçalo lighthouse point in the Azores baseline
Romania	RO	*N.D.*	*N.D.*	
Sweden[1]	SE[1]	720	2	
Slovenia	SI	298	531	Declaration exceeding the EEZ
Slovenia[1]	SI[1]	118	210	Declaration of roughly the EEZ

Table 5. Difference, both in area and in percentage, between the national definitions reported by Member States pursuant to the WFD and the European coastal waters estimated in this work. A positive difference value means that the national declaration is larger than the estimation of this work. *N.D.*: No available declaration. [1]Estimated after the River Basin District limits because they differ from the coastal water limits.

Significance of the European coastal waters limit

The outer limit of the WFD jurisdiction has not been a relevant issue during the first cycle of application of the Directive (2000-2010). Meanwhile, the implementation of the MSFD, which has a clear geographical interaction with the WFD, has started. The MSFD applies to all marine waters extending from the baseline to the outmost reach of the area where a Member State has and/or exercises jurisdictional rights (Directive 2008/56/EC). Therefore, the WFD and the MSFD overlap partially in the coastal waters. In general, the WFD prevails in the overlap area, although the MSFD must be also applied for particular aspects of the environmental status that are not addressed through the WFD (for example, in the case of specific litter and noise measures).

Under the MSFD, the initial assessment of the current environmental status and the impact of human activities on marine waters must be reported by 2012. The near-shore area included in that assessment will certainly have a large impact in the results, as most of the human impacts have their origin inland. In agreement with Hering et al. (2010), we recommend to set a clear geographical delimitation of jurisdiction between the WFD and the MSFD. This is a most basic requirement for correct analysis of the ecological/environmental status of the water bodies under both Directives. A proper delimitation would reduce significantly the efforts of ecological assessment, monitoring and scientific advisory tasks. In the long-term, the environmental requirements under the two Directives should be merged and harmonised.

Concerning other relevant EU legislation, coastal waters are not specifically defined either under the ICZM recommendation or in the IMP. Adopting the WFD definition of coastal waters (after having verified that there is no conflict with any applying Regional Sea Conventions) will enhance the efficiency and efficacy of the scientific and socio-economic analyses and will facilitate implementation. Furthermore, the IMP aims at easing the sustainable development of all sea-related activities. One of the main tools to reach this goal will be maritime spatial planning, closely linked to the ICZM plans. A proper delimitation of European coastal waters at a continental scale can be an essential element for maritime spatial planning.

Possible modifications in the definition of coastal waters

There are certain cases where a punctual revision of the coastal waters definition is advisable. This is the case, for example, for some sites where marine waters are completely surrounded by coastal waters in a semi-closed bay or an archipelago (e.g. eastern Irish bays, some Greek bays, among Shetland Islands), or sites where coastal waters reach more than 200 m of depth (e.g. mid-Norway) or even over 500 m depth (e.g. in Azores and Canary Islands). A natural boundary (based, for example, on an appropriately fixed bathymetric contour in each bio-geographical region) could be more suitable for the delimitation of environmental zones rather than human-defined maritime boundaries.

It must be noted that the ecological assessment of certain sites can be biased because the coastal delimitation does not necessarily correspond to ecological boundaries. In addition to the abovementioned sites where a revision is advised, the 1 nm line misses the largest part of wide eutrophic plumes which must be clearly delineated and monitored (Ferreira et al., 2010). Hence, probably, the most critical issue in the geographic delimitation between the WFD and the MSFD relates to transitional waters and, in particular, to the cases where these waters extend beyond the 1 nm.

The Waterbase dataset (The European Topic Centre on Water, 2010) contains data on water monitoring and flux stations within the European transitional, coastal and marine waters. An analysis of the 290 non-fluvial WFD monitoring stations of this database pointed out that less than 5% of those stations fall beyond the coastal waters as defined in

this paper (i.e. further offshore). This percentage gives an idea of the marginal amount of monitoring activities developed near the offshore border of coastal waters within the WFD and, thus, the relatively small adjustment that would generate a prompt modification of that border. Moreover, making this delimitation unique and public would promote the development of supplementary and comparable scientific studies other than strictly WFD- or MSFD-related projects (e.g. Borja et al., 2009).

The great variety of one-sided national modifications observed in the delimitation of coastal waters with respect to the WFD definition should be avoided if not duly justified. A full consultation process is advised to conclude the work started with this study. At least three issues should be examined, to decide whether national declarations are to be accepted as they are: (i) what are the possible "motivated exemptions" in the delimitation of coastal waters with respect to the WFD definition, (ii) can these exemptions be applied by all Member States on the same basis, and (iii) do these exemptions have consequences in the assessment of the ecological/environmental status. In any case, a detailed analysis and update of the coastal and transitional waters delimitations by the European Commission should be conducted.

CONCLUSIONS

The delimitation of European coastal waters, as related to maritime administrative boundaries, is a controversial issue, but it is also highly relevant for the implementation of the WFD and the MSFD, among other regulations. This report proposes the first pan-European delimitation of coastal waters at a continental scale. According to the delimitation proposed, European coastal waters cover 553,817 km^2, 340,524 km^2 of which corresponding to EU Member States.

Numerous inconsistencies are observed between the official national delimitations of costal waters, and the coastal waters delimited in this work following closely the WFD definition. Under certain circumstances, the definition proposed in this report could be revised to fit better with ecological boundaries. Otherwise, the possible misclassification of coastal waters may bias the ecological assessment of certain areas. However, each Member State seems to propose particular modifications to the general definition, accounting for a general overestimation of +29,337 km^2 (nearly 12% of the compared area) with respect to the results of this work. On the contrary, it seems that national governments do not include in their declarations all the water bodies scientifically described as transitional. These deviations, if accepted, should be explicitly discussed and justified. The present work provides the basis for a comparative analysis and consultation with all the interested parties. The geographical results will be publicly available (and are presently available on request) to facilitate the revision by scientists and stakeholders.

Finally, it is recommended that a clear geographical limit is set up between the WFD and the MSFD jurisdiction in order to (i) facilitate the monitoring and assessment of the ecological/environmental status under both directives, and (ii) promote the development of supplementary and comparable scientific and socio-economic studies.

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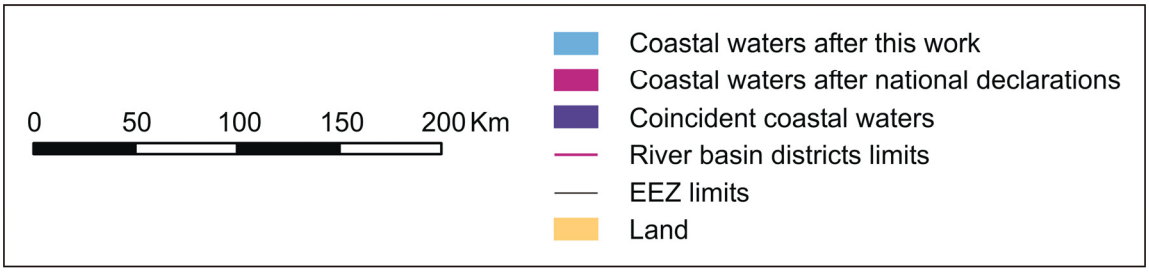
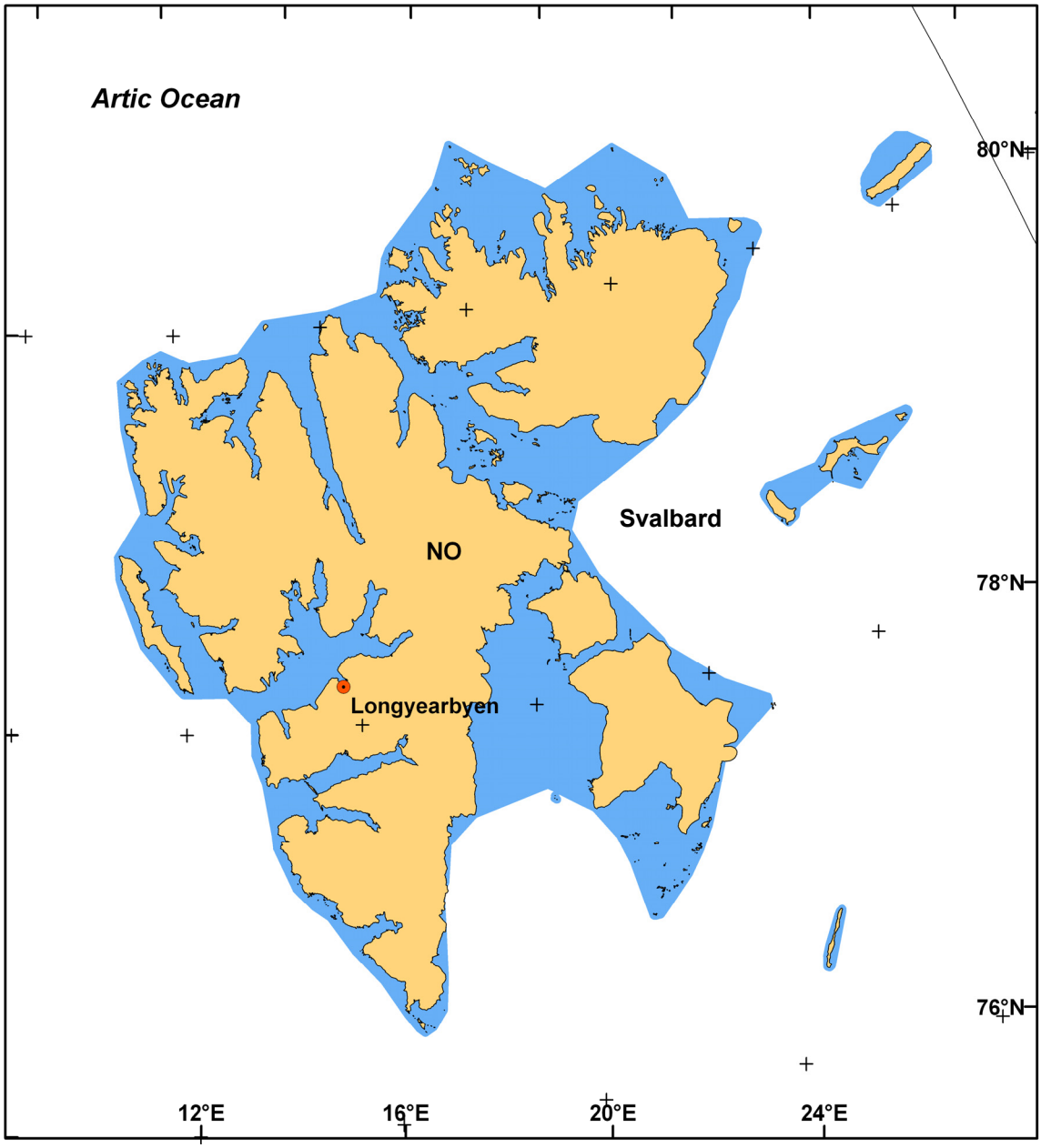
ANNEX 1

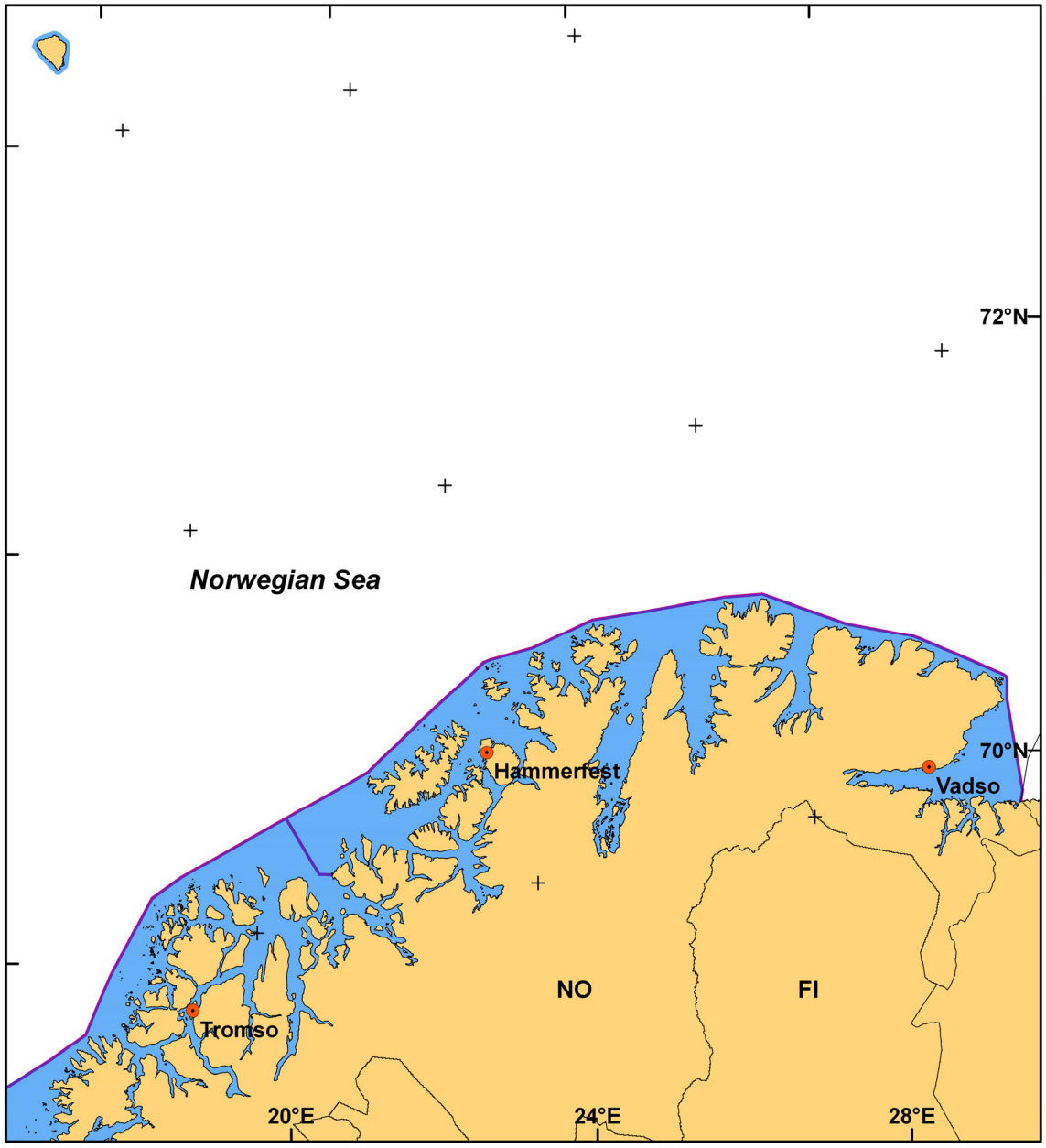
The maps in this annex show the geographic comparison between the European coastal waters as mapped in this study and the national declarations under the WFD. River Basin Districts and EEZ limits are also illustrated. Map projections are: Lambert Azimuthal Equal Area datum ETRS 1989 (maps 1-32), Albers Conical Equal Area datum South American 1969 (maps 33-34), and Africa Lambert Conical Equal Area datum WGS 1984 (map 35). See maps location in figure 2.



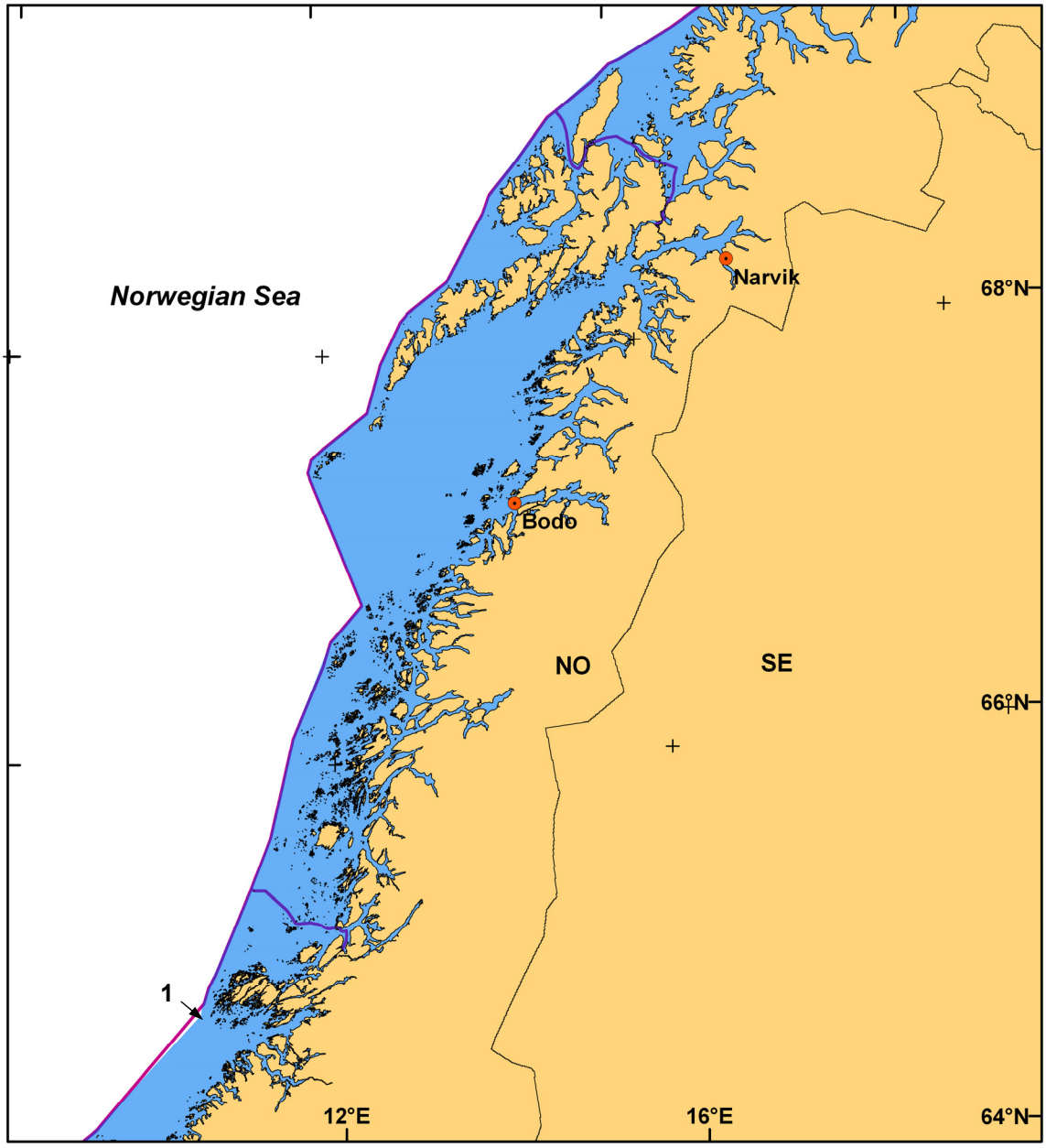
Legend for all the maps in Annex 1 except map 31



Map 1 of Annex 1



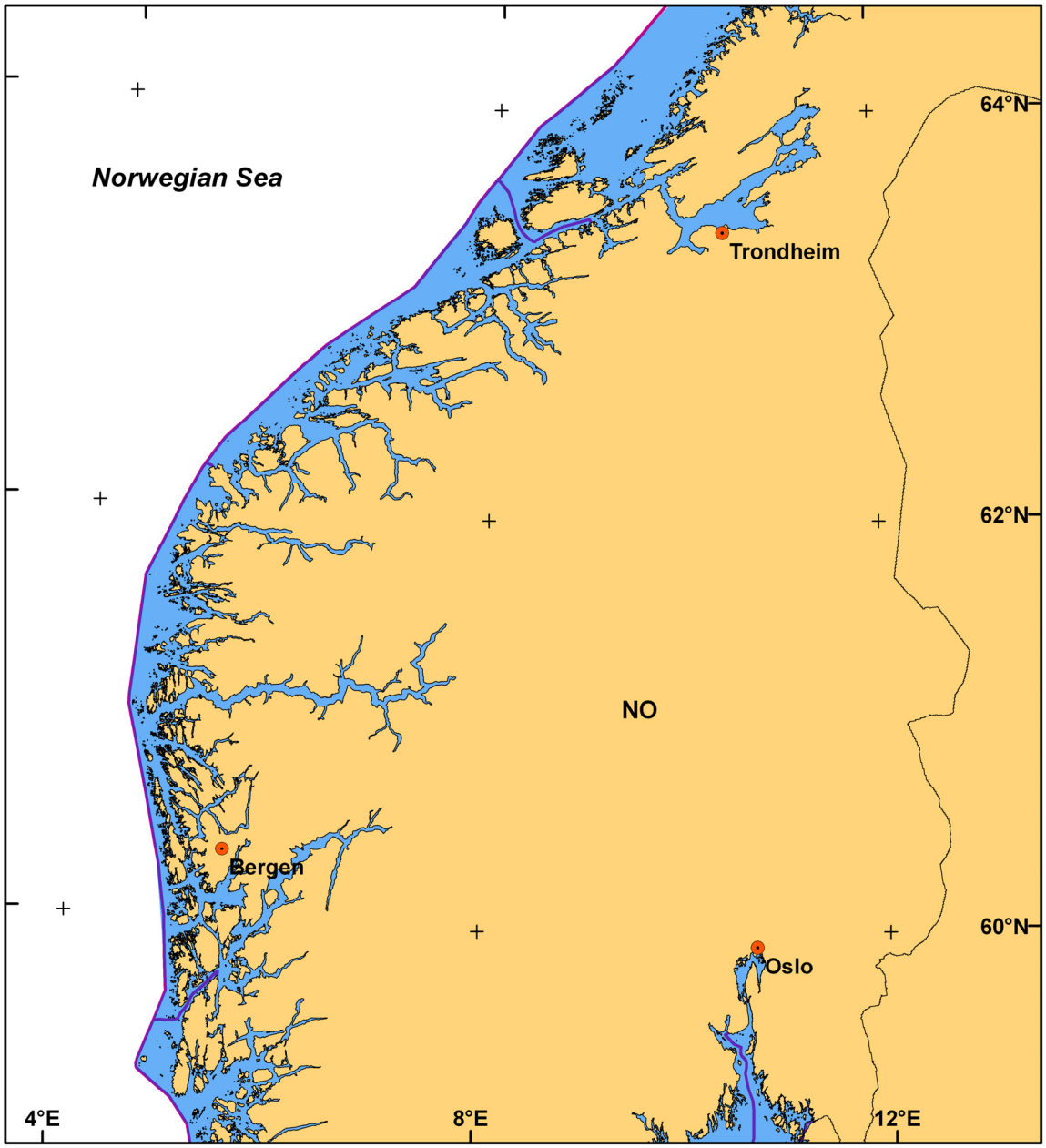
Map 2 of Annex 1



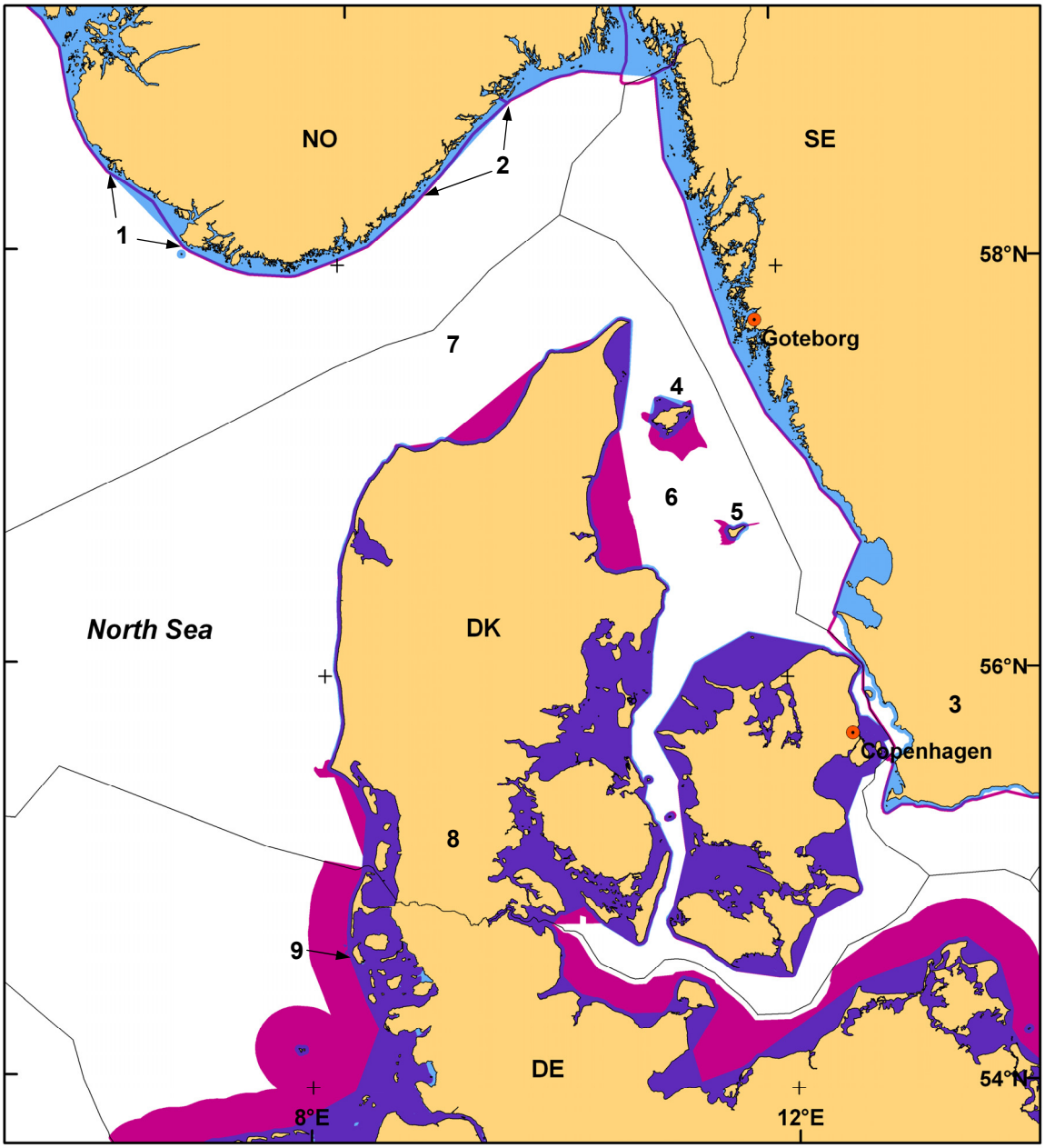
Map 3 of Annex 1

Site mentioned in the text:

1 - Point NM49 of the Norwegian baseline (table 4)



Map 4 of Annex 1



Map 5 of Annex 1

Sites mentioned in the text:

1 - Points NM82 and NM83 of the Norwegian baseline (table 4)

2 - Points NM97 and NM98 of the Norwegian baseline (table 4)

3 - County of Skåne (table 4)

4 - Laeso Island (tables 2 and 4)

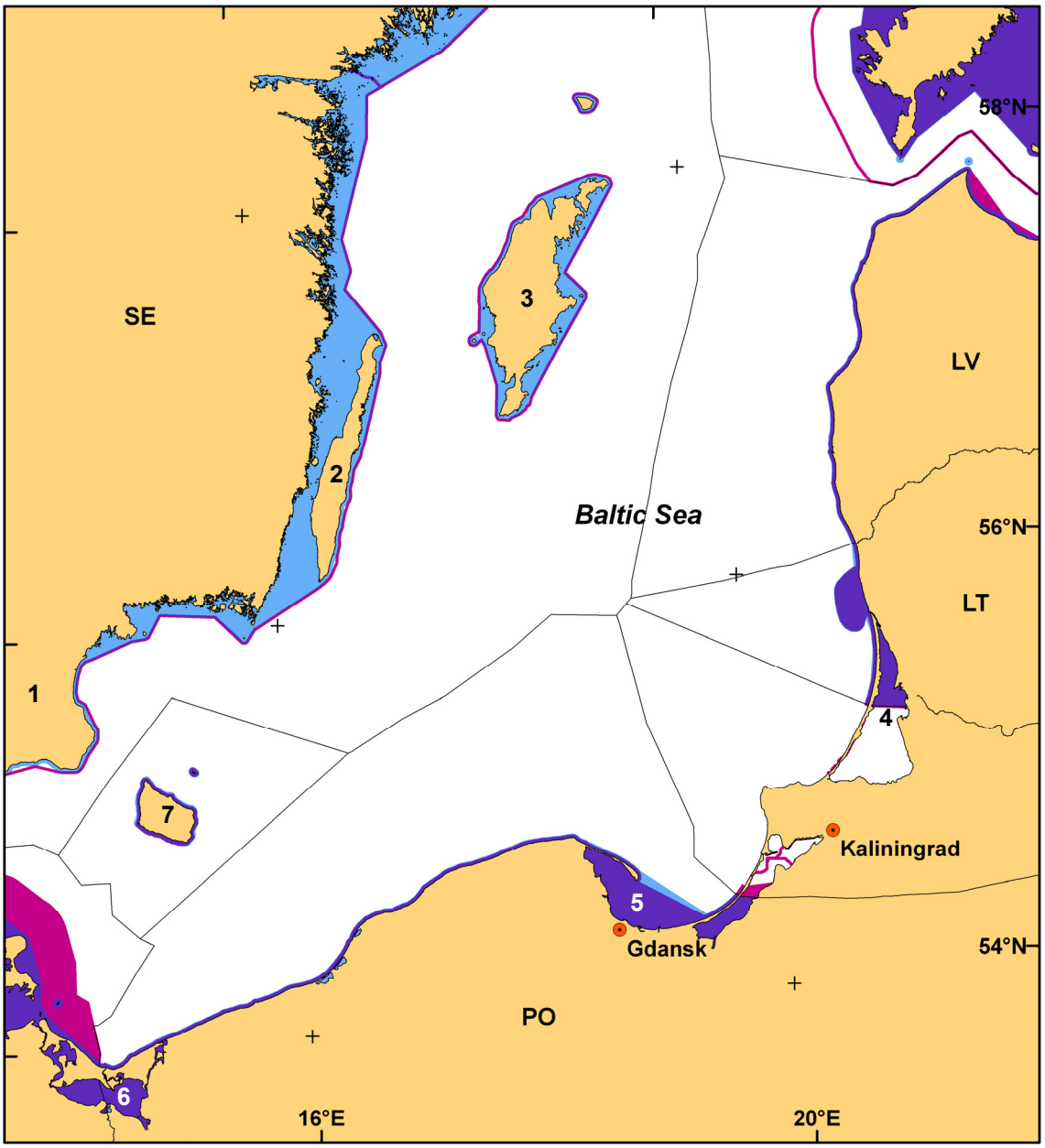
5 - Anholt Island (table 4)

6 - Kattegat (table 4)

7 - Skagerrak (table 4)

8 - Syddanmark region (table 4)

9 - Amrum island (table 2)



Map 6 of Annex 1

Sites mentioned in the text:

1 - County of Skåne (table 4)

2 - Öland Island (table 4)

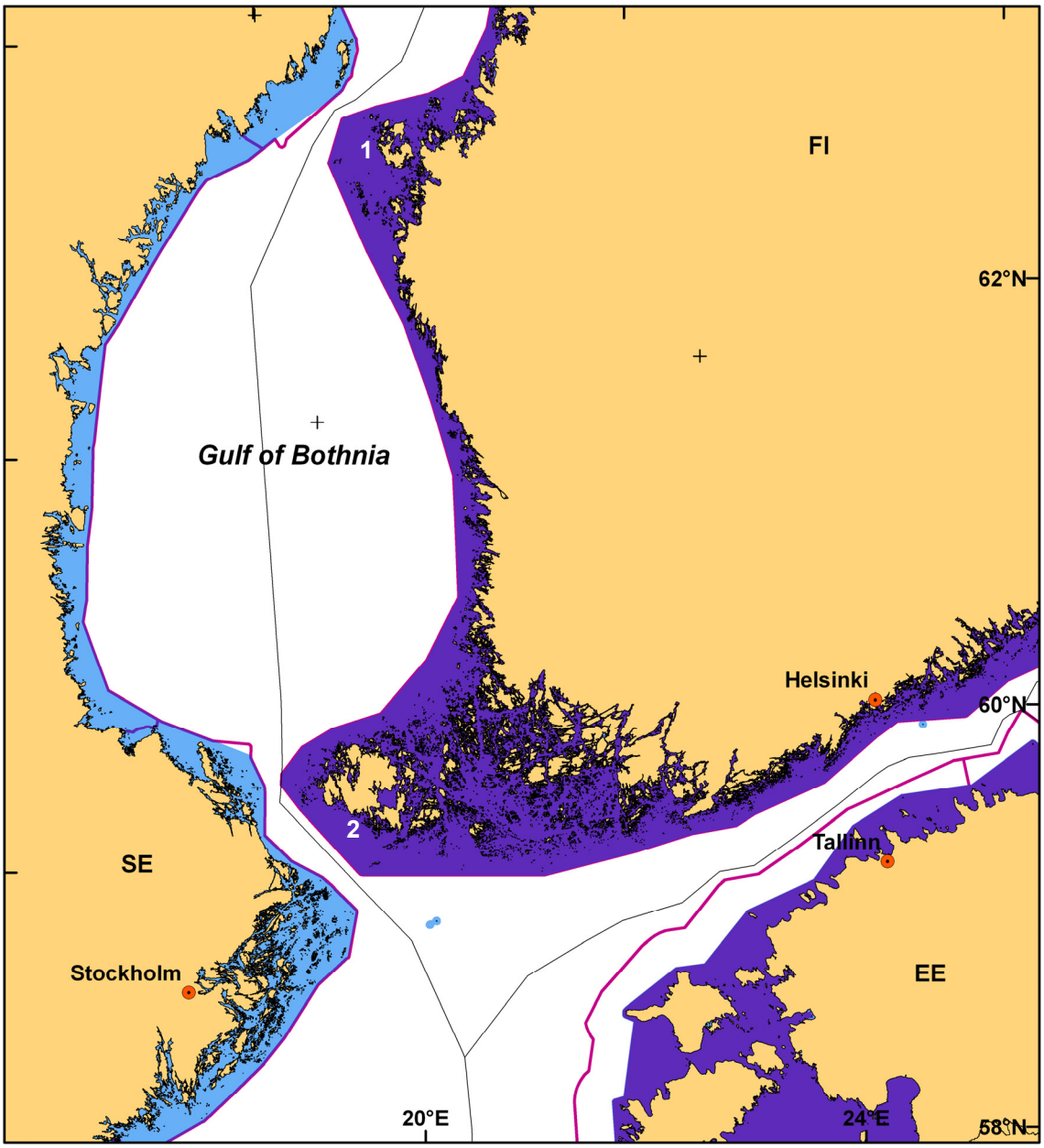
3 - Gotland Island (table 4)

4 - Curonian Lagoon (table 2)

5 - Gulf of Gdańsk (table 4)

6 - Szczecin Lagoon (table 2)

7 - Bornholm (table 3)

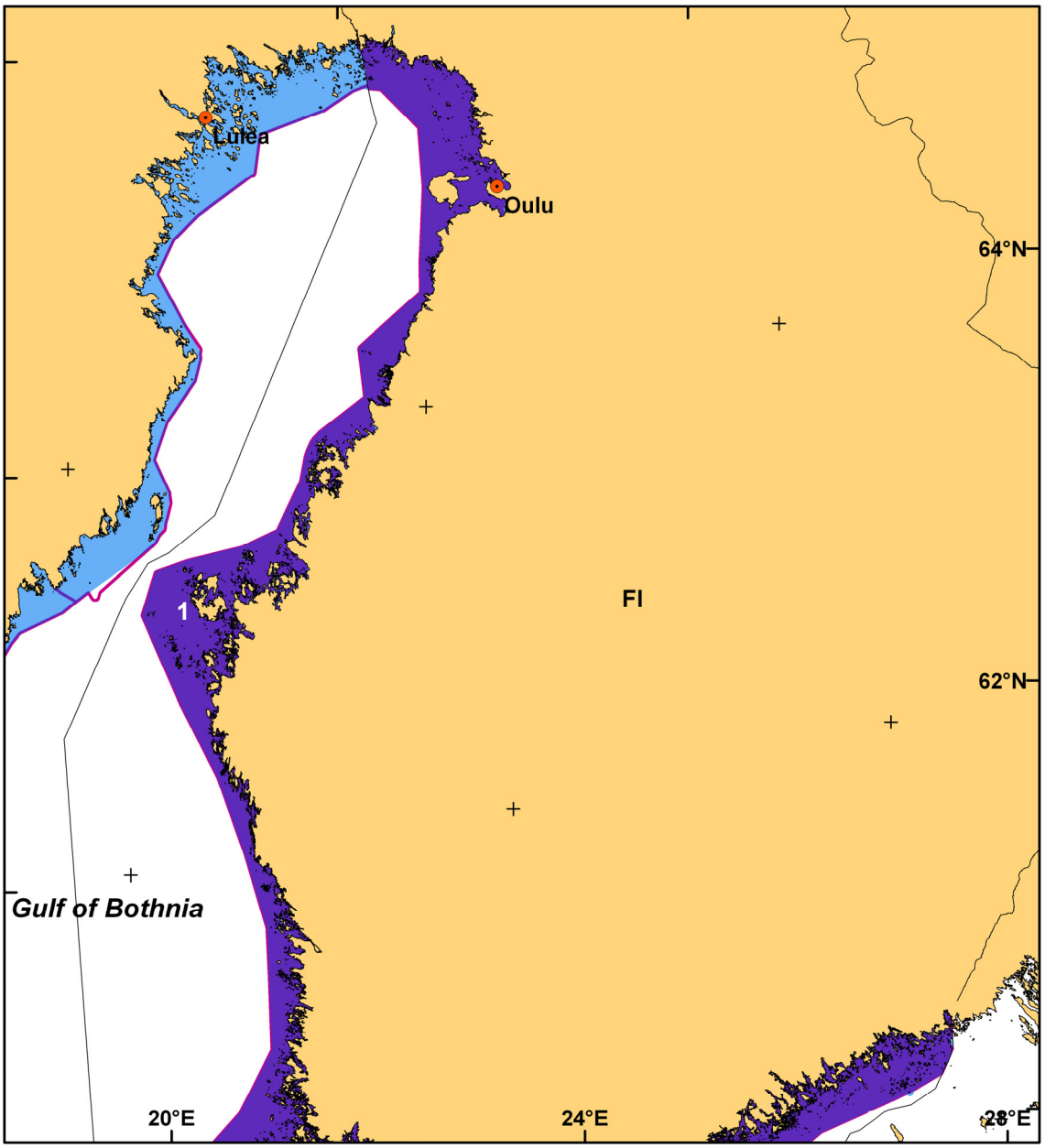


Map 7 of Annex 1

Sites mentioned in the text:

1 - Kvarken Archipelago (table 4)

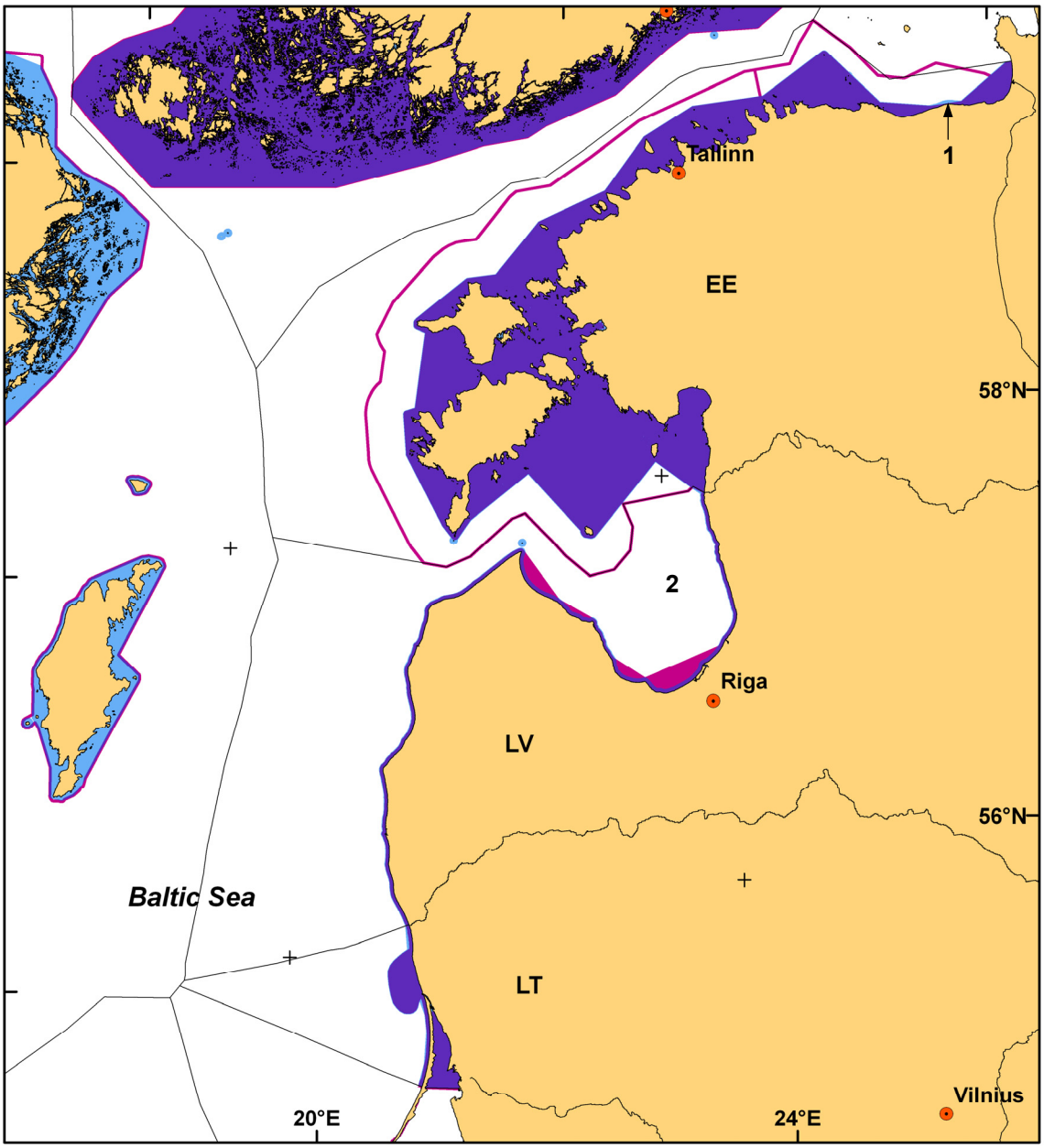
2 - Aland Islands (table 4)



Map 8 of Annex 1

Site mentioned in the text:

1 - Kvarken Archipelago (table 4)

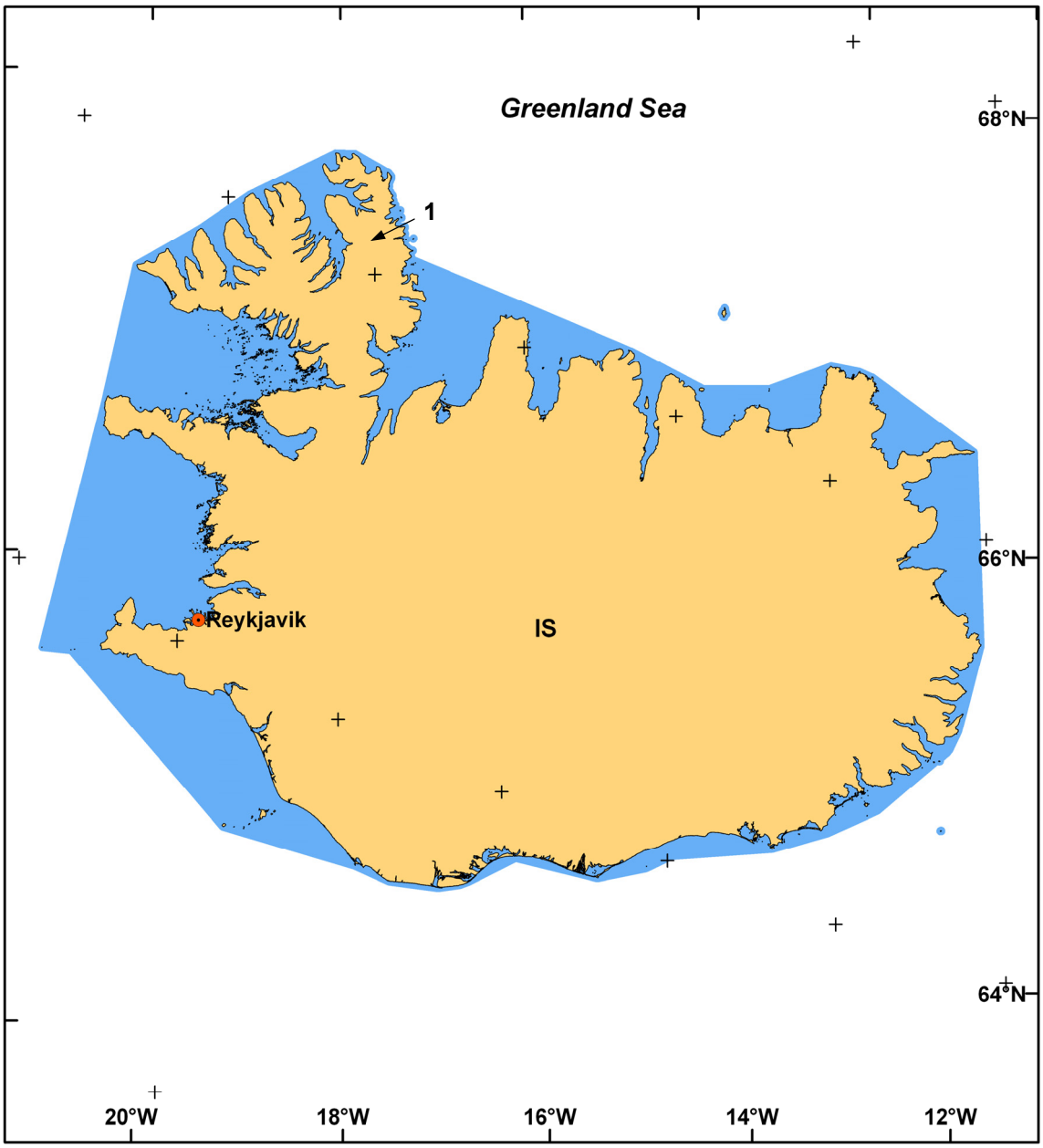


Map 9 of Annex 1

Sites mentioned in the text:

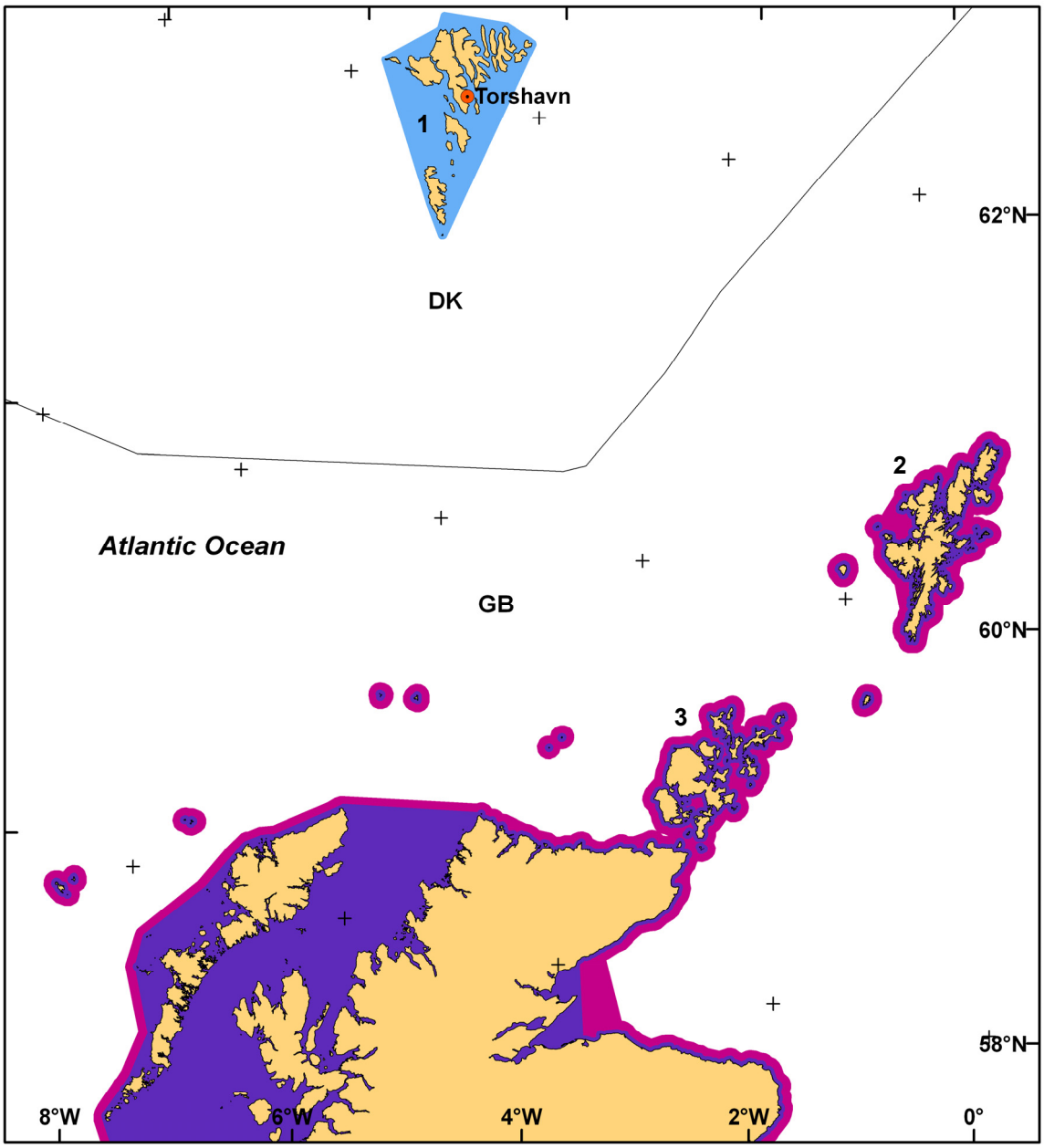
1 - Kohtla-Järve (table 4)

2 - Gulf of Riga (table 4)



Map 10 of Annex 1

1 - Point Asbúdharrif of the Icelandic baseline, which lays inland after the data used in this work. For this reason, the baseline was supposed to follow the coastline around this point.



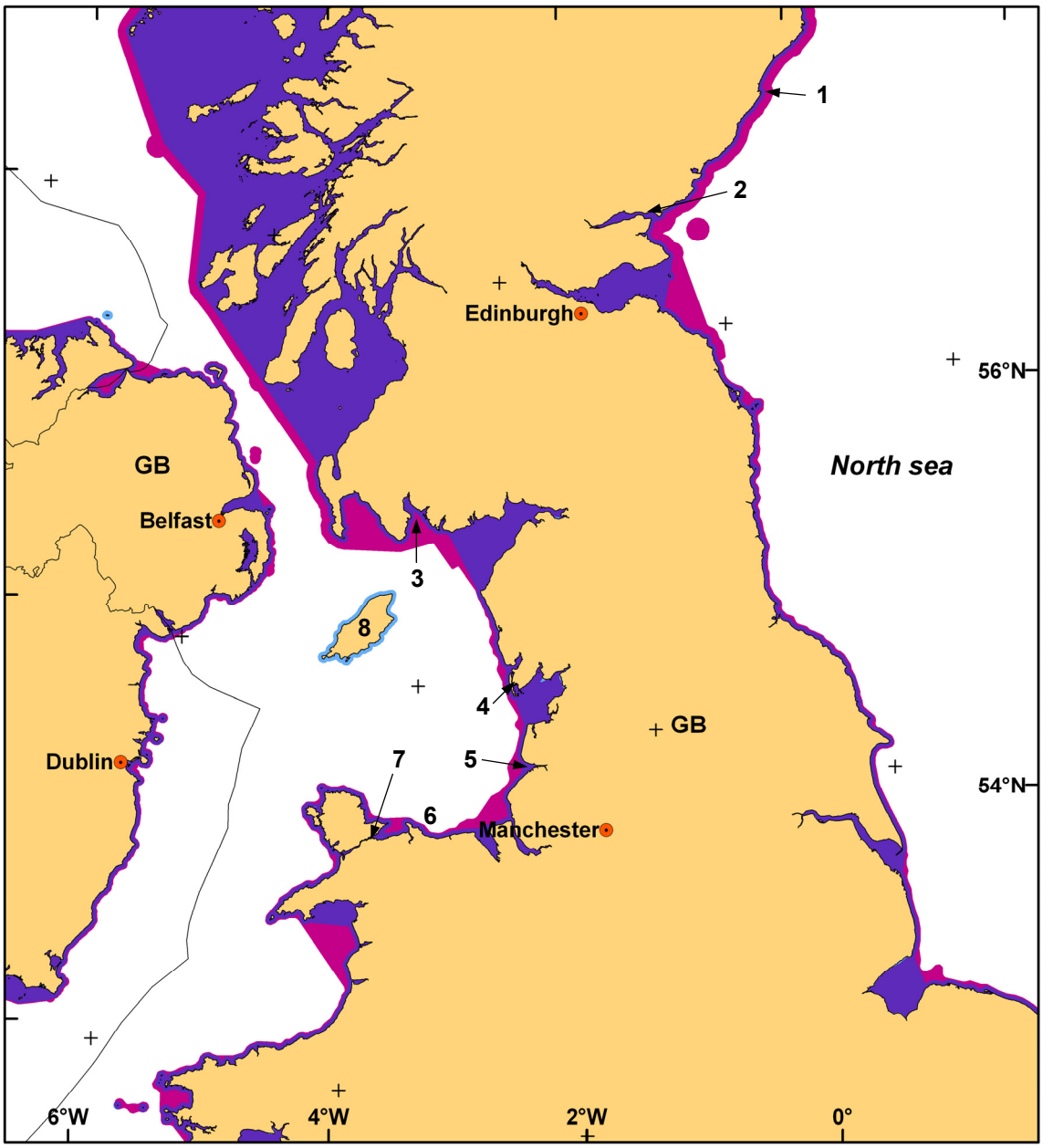
Map 11 of Annex 1

Sites mentioned in the text:

1 - Faroe Islands (table 3)

2 - Shetland Islands (table 4)

3 - Orkney Islands (table 4)



Map 12 of Annex 1

Sites mentioned in the text:

1 - Dee Estuary (table 2)

2 - Firth of Tay (table 2)

3 - Cree Estuary (table 2)

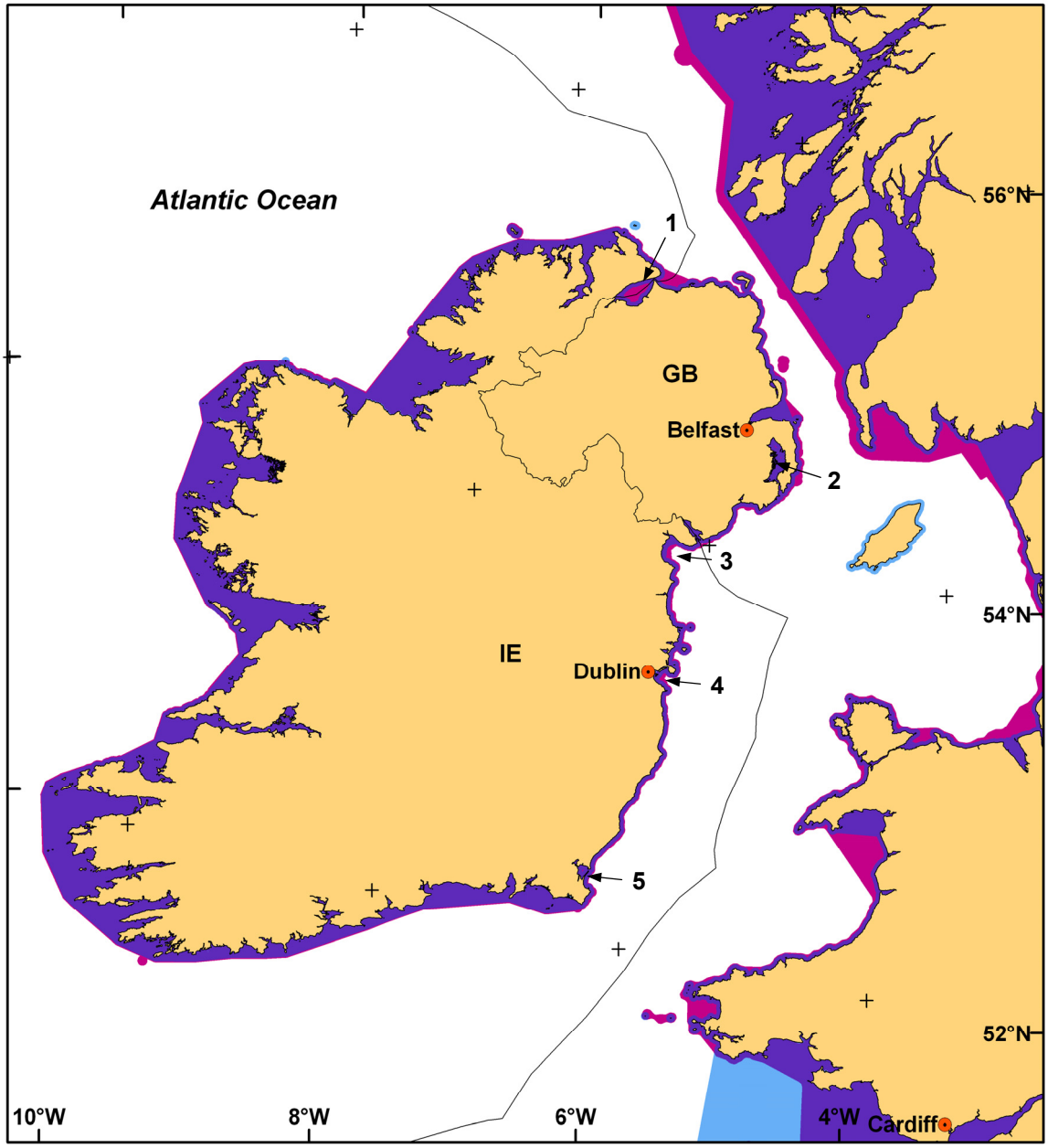
4 - Barrow-in-Furness (table 2)

5 - Ribble Estuary (table 2)

6 - Colwyn Bay (table 2)

7 - Bangor (table 2)

8 - Isle of Man (tables 3 and 4)



Map 13 of Annex 1

Sites mentioned in the text:

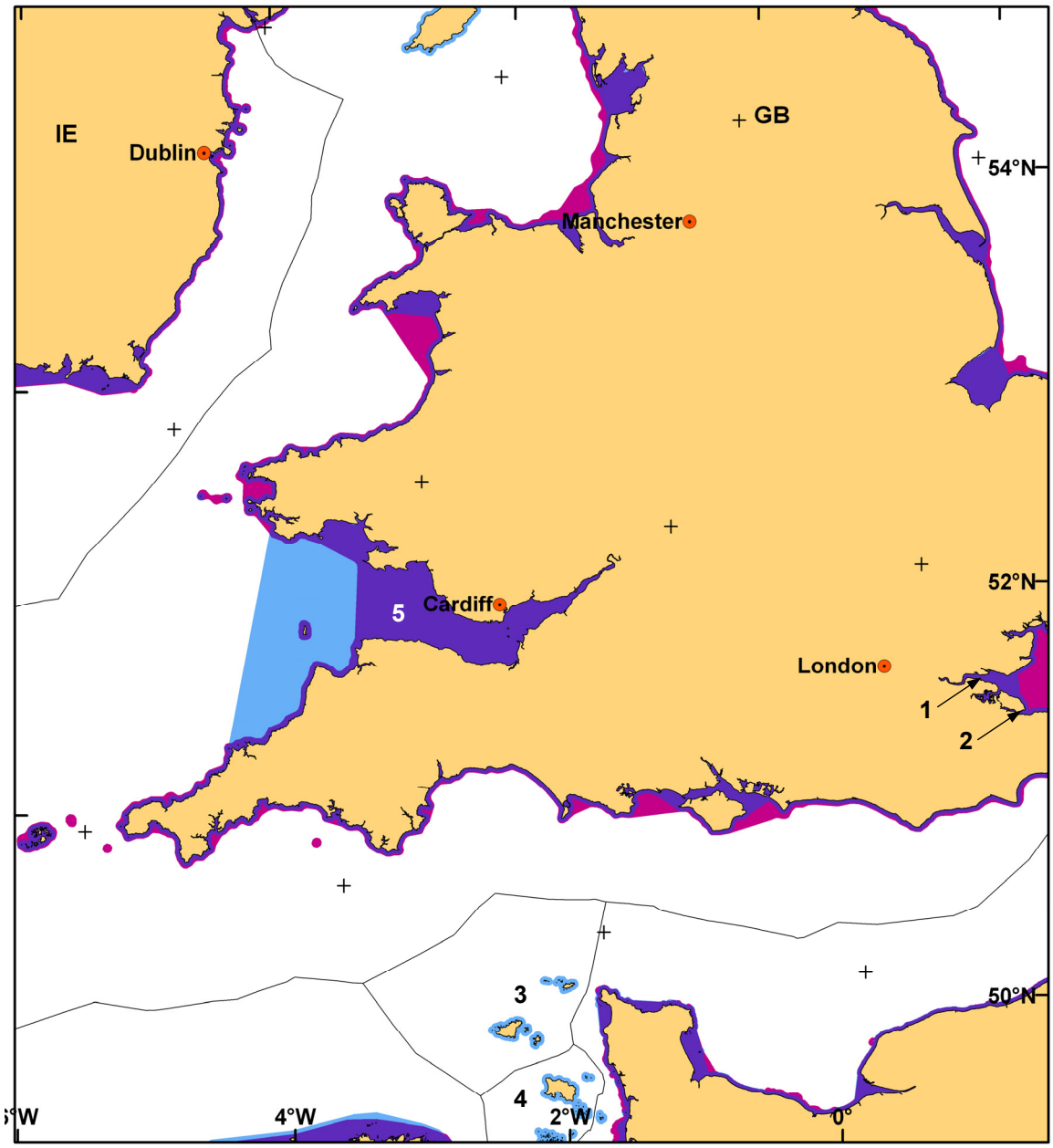
1 - Foyle Lough (table 2)

2 - Strangford Lough (table 2)

3 - Dundalk Bay (tables 2 and 4)

4 - Dublin Bay (tables 2 and 4)

5 - Slaney Estuary (table 2)



Map 14 of Annex 1

Sites mentioned in the text:

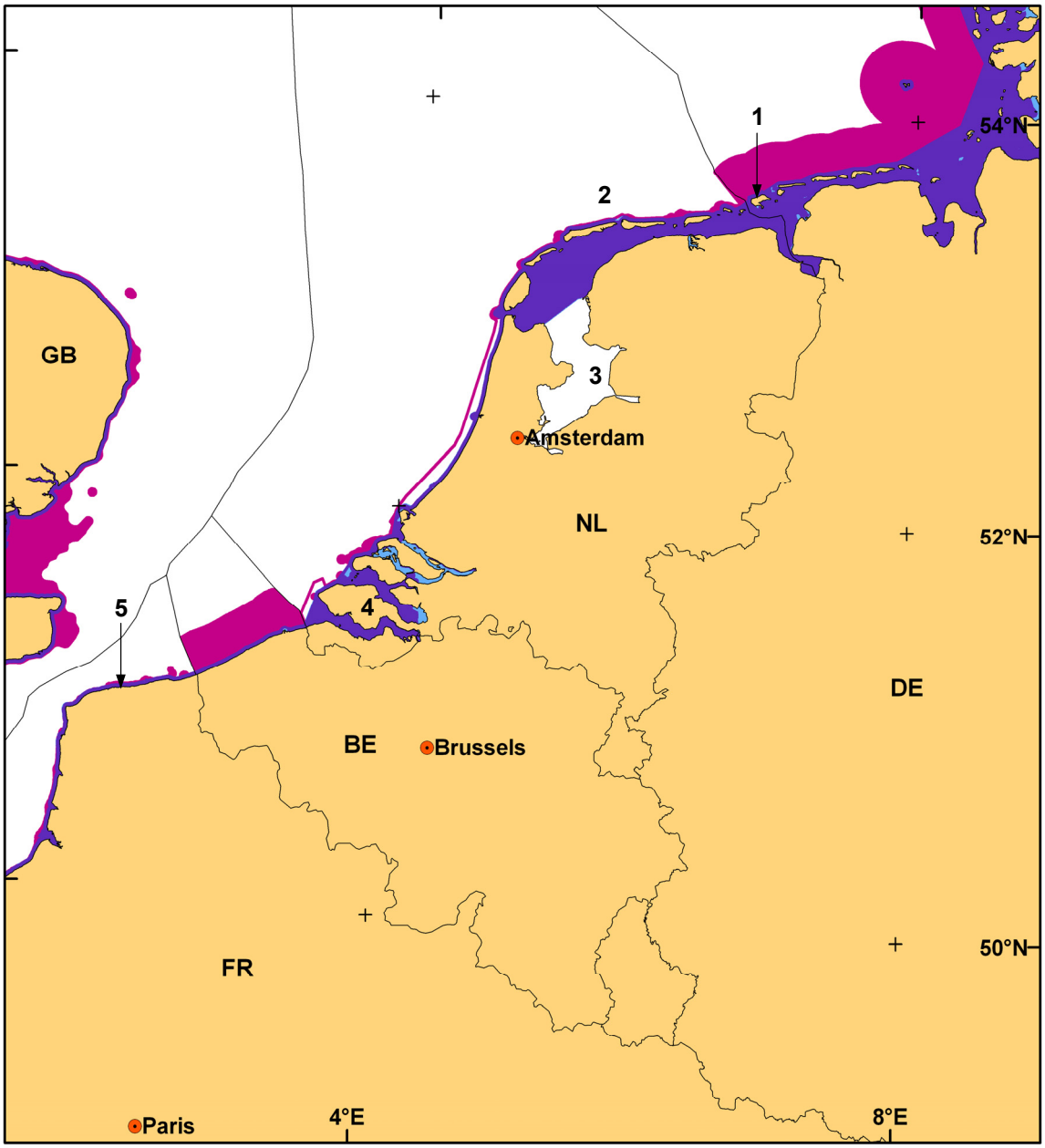
1 - Thames Estuary (table 2)

2 - Swale Estuary (table 2)

3 - Guernsey Islands (tables 3 and 4)

4 - Jersey Islands (tables 3 and 4)

5 - Bristol Channel (table 4)



Map 15 of Annex 1

Sites mentioned in the text:

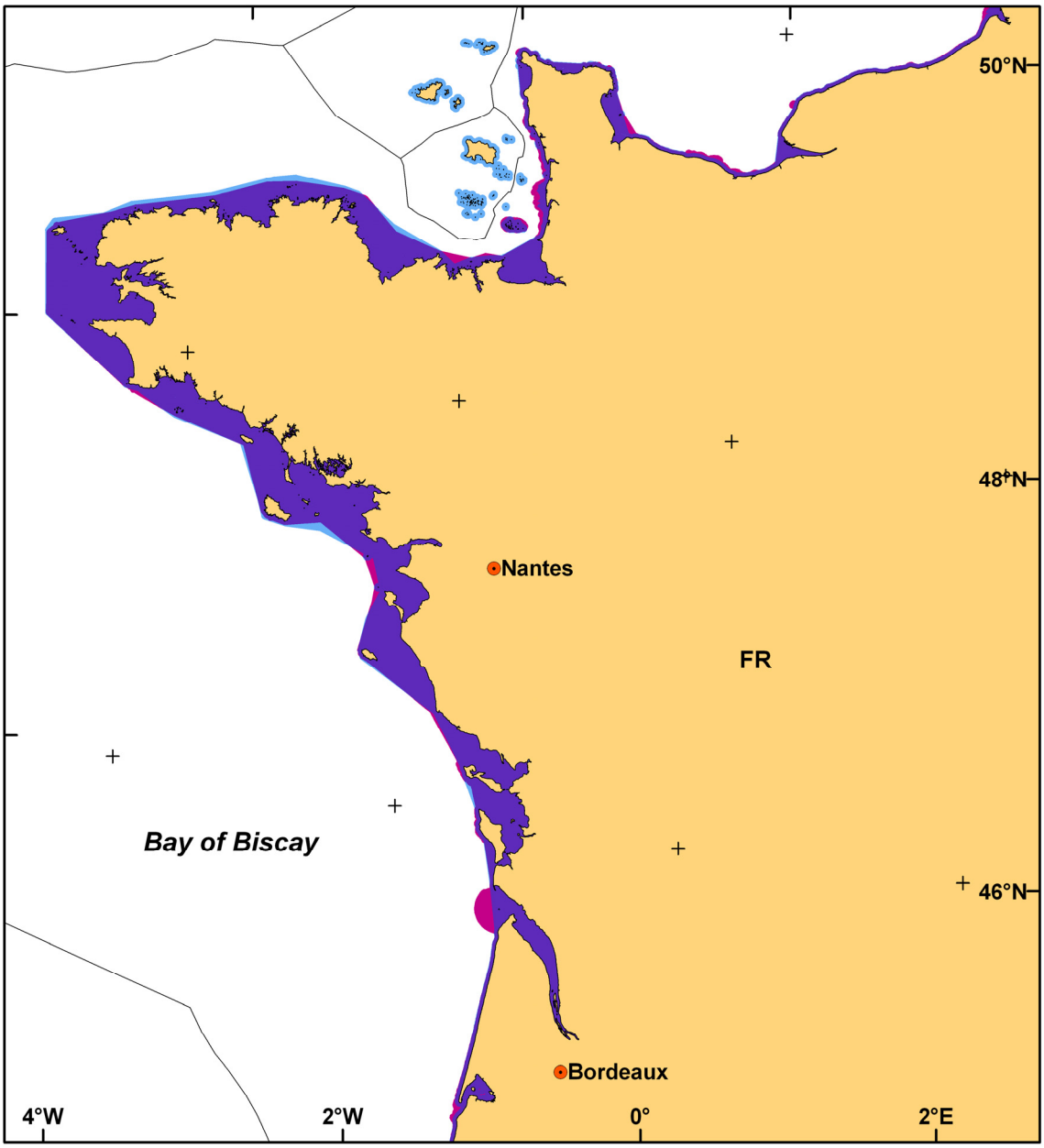
1 - Borkum island (table 2)

2 - Dutch Frisian Islands (table 4)

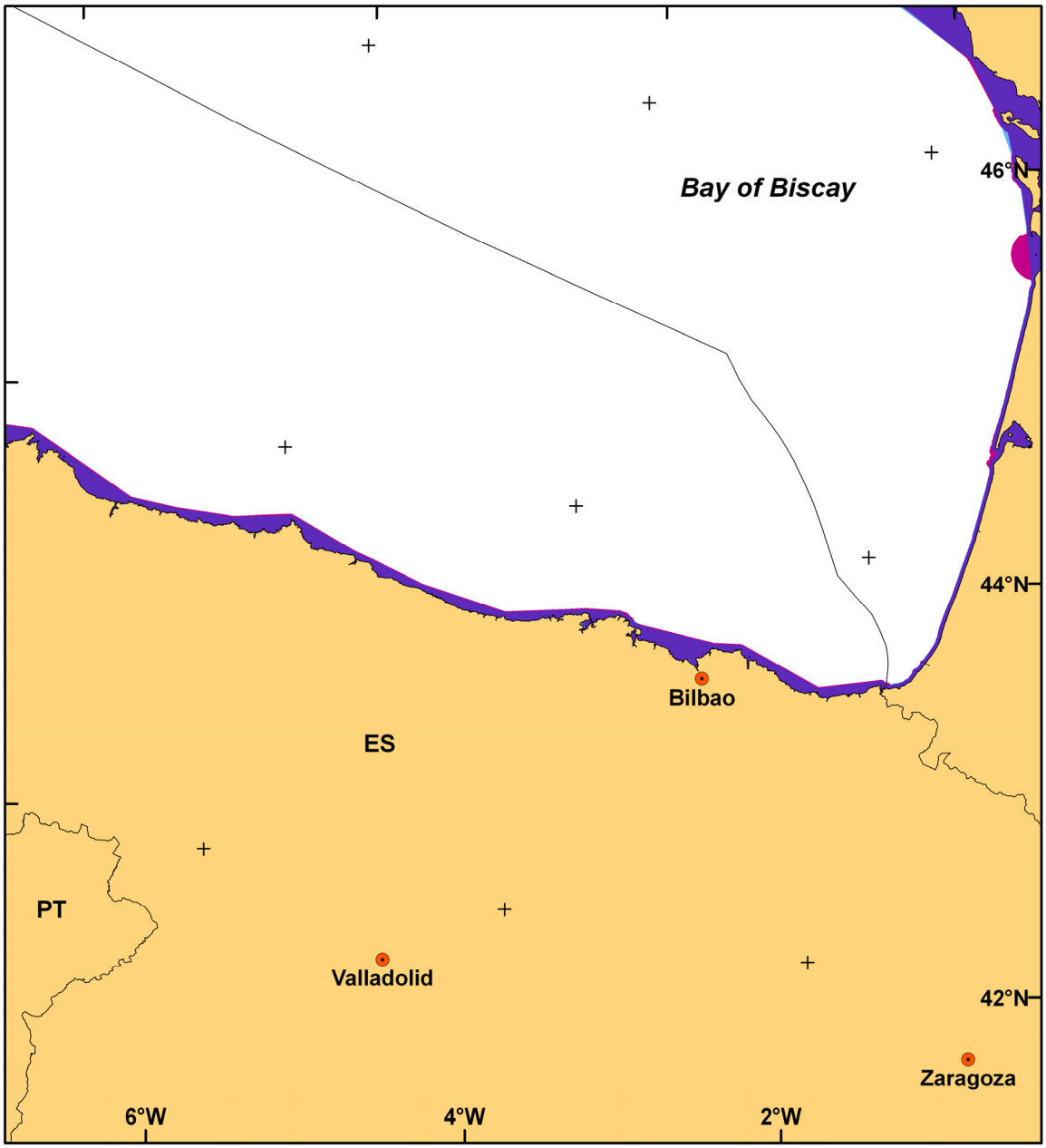
3 - Ijsselmeer and Markermeer (table 4)

4 - Zeeland province (table 4)

5 - Port of Dunkerque (table 2)

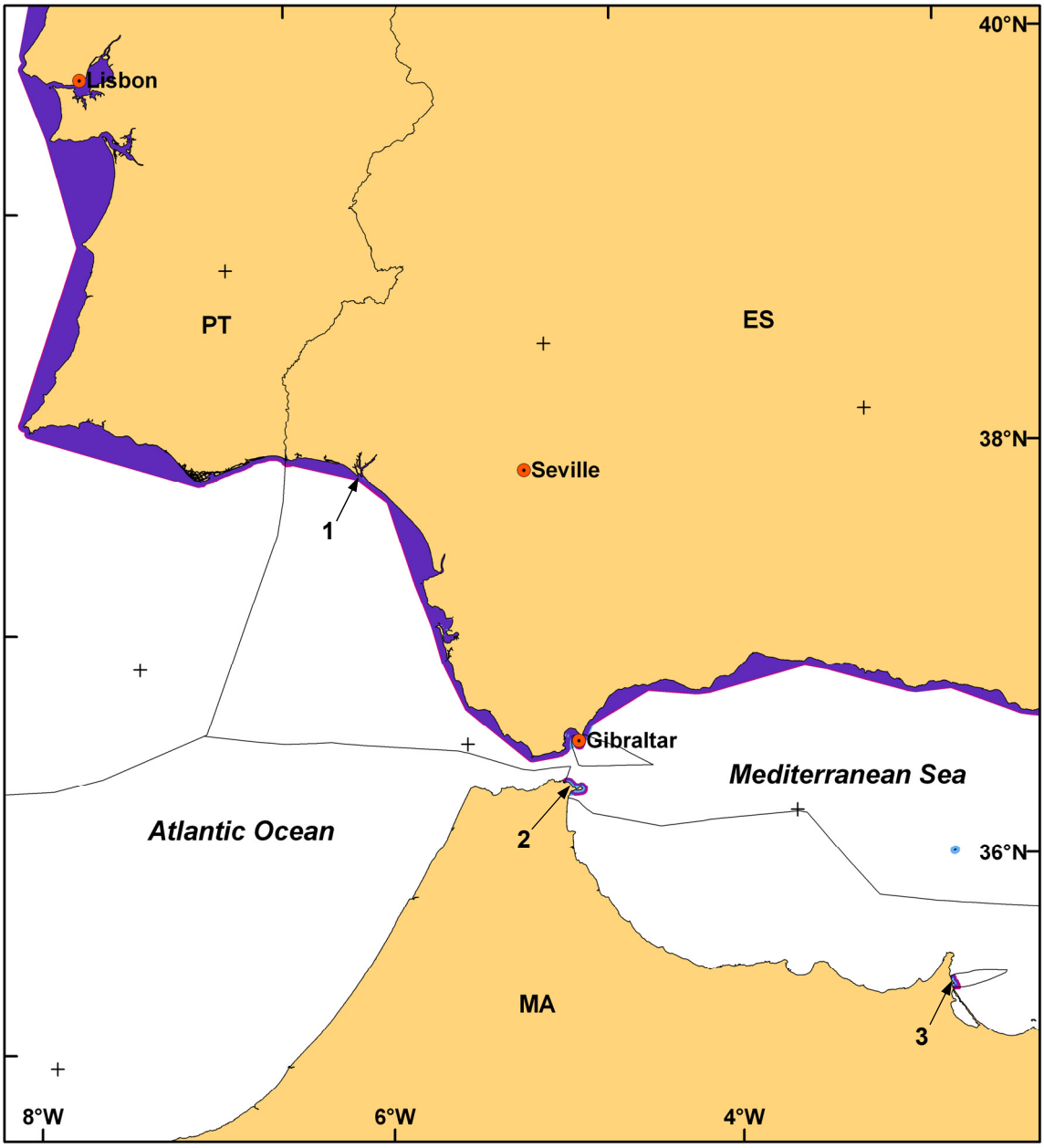


Map 16 of Annex 1



Map 17 of Annex 1

Map 18 of Annex 1



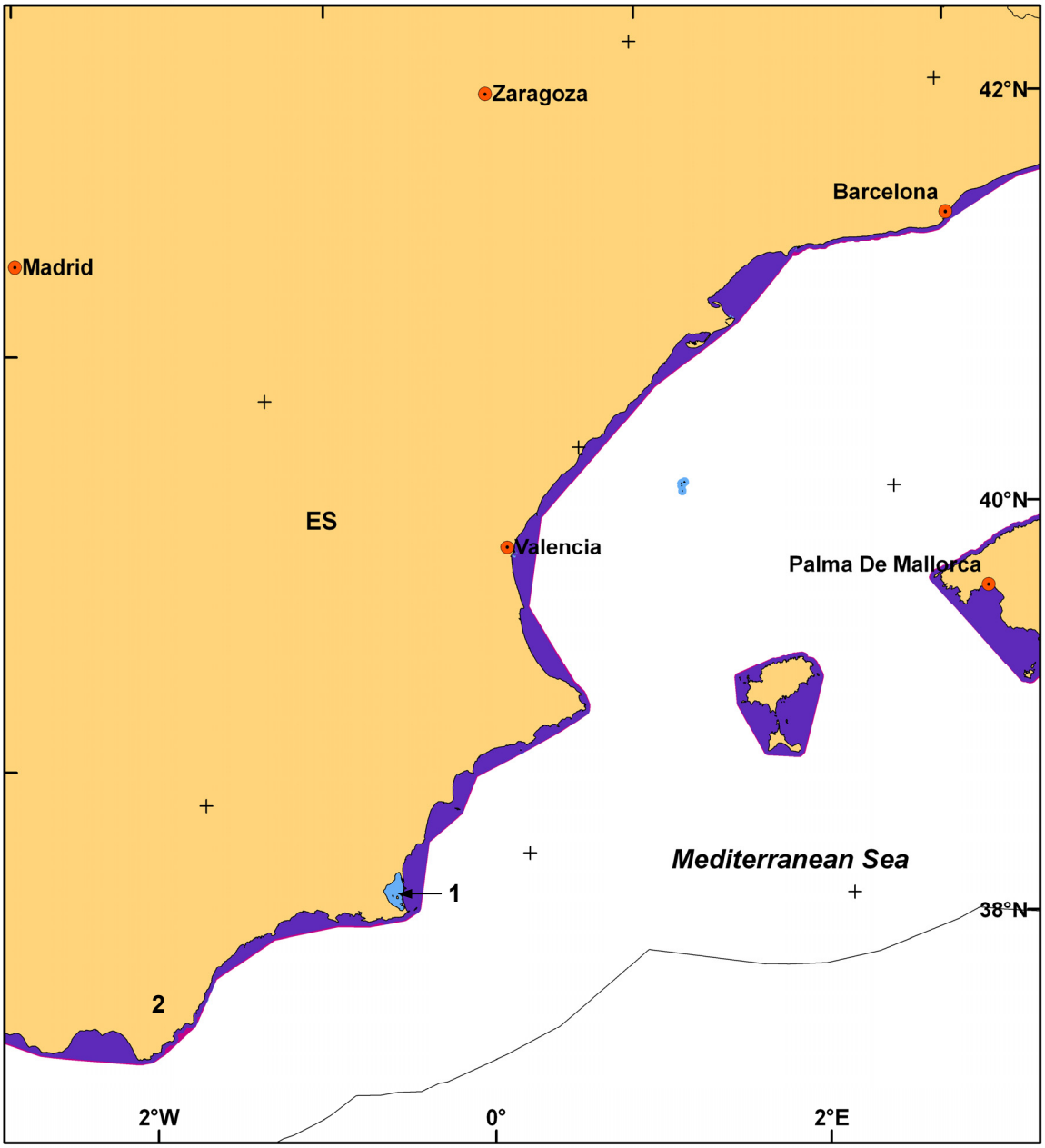
Map 19 of Annex 1

Sites mentioned in the text:

1 - Tinto-Odiel Estuary (table 2)

2 - Ceuta (tables 3 and 4)

3 - Melilla (tables 3 and 4)



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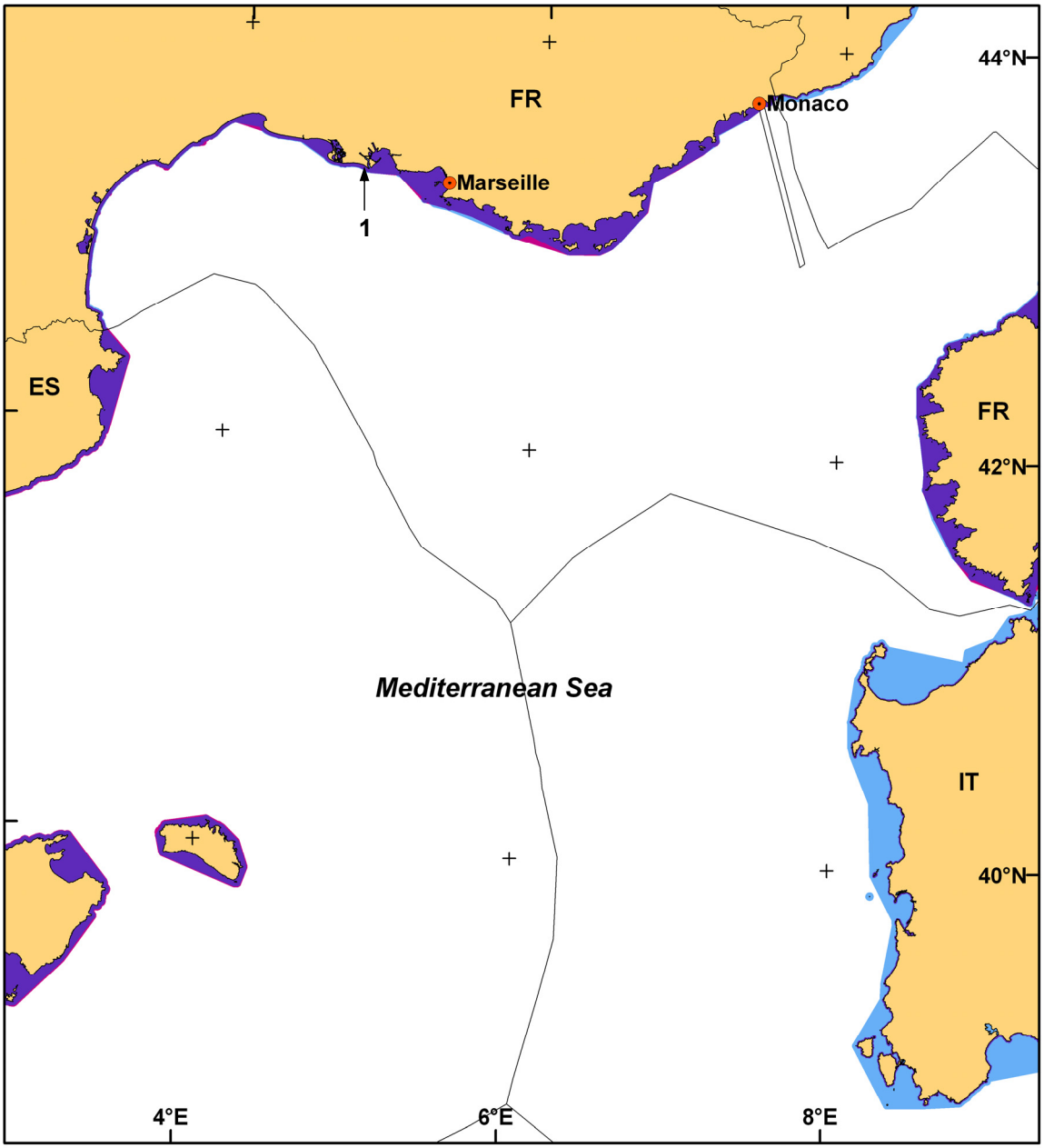
Sites mentioned in the text:

1 - Mar Menor (table 4)

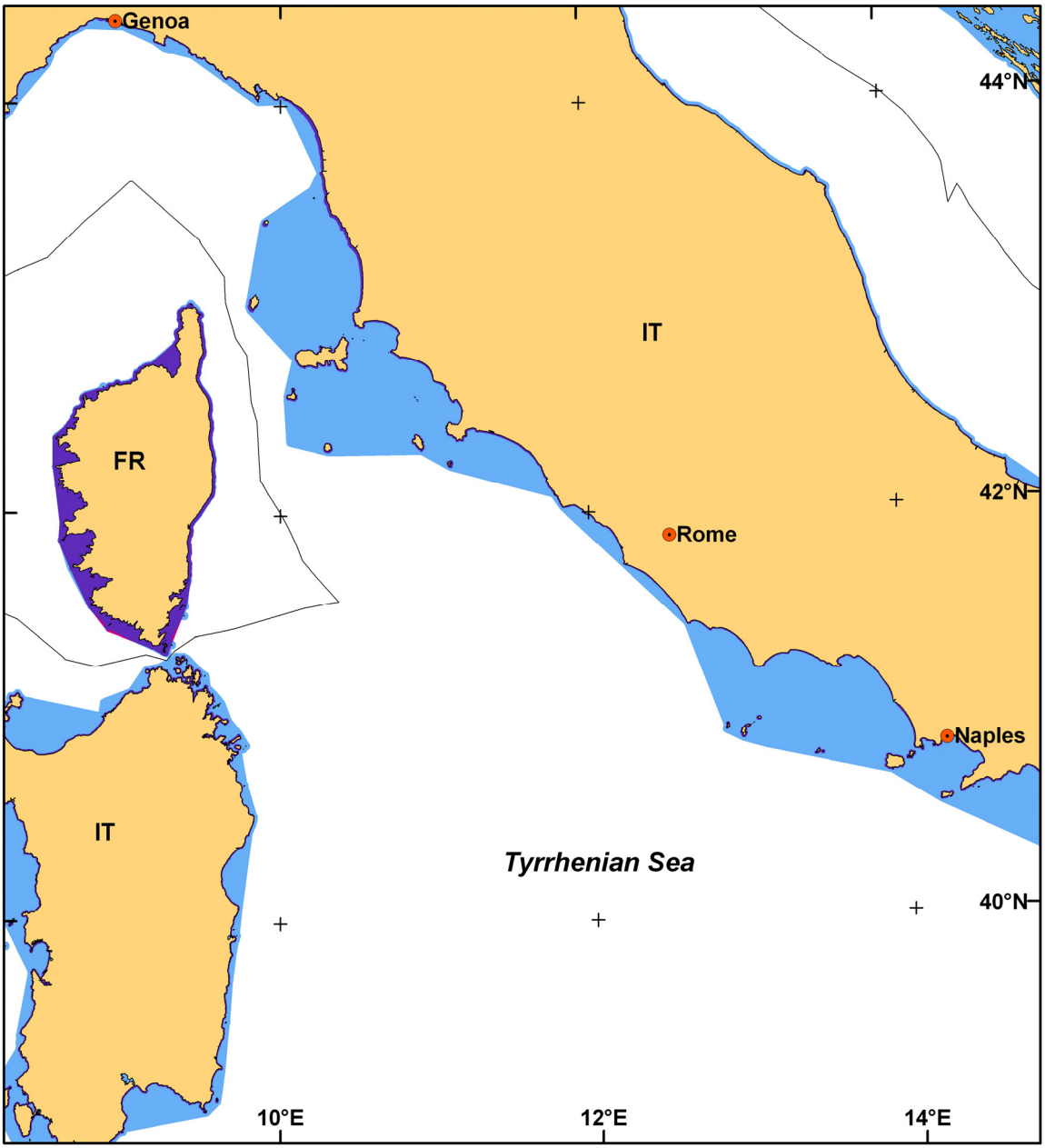
2 - Almeria (table 4)



Map 21 of Annex 1

Site mentioned in the text:

1 - Rhone Delta (table 2)



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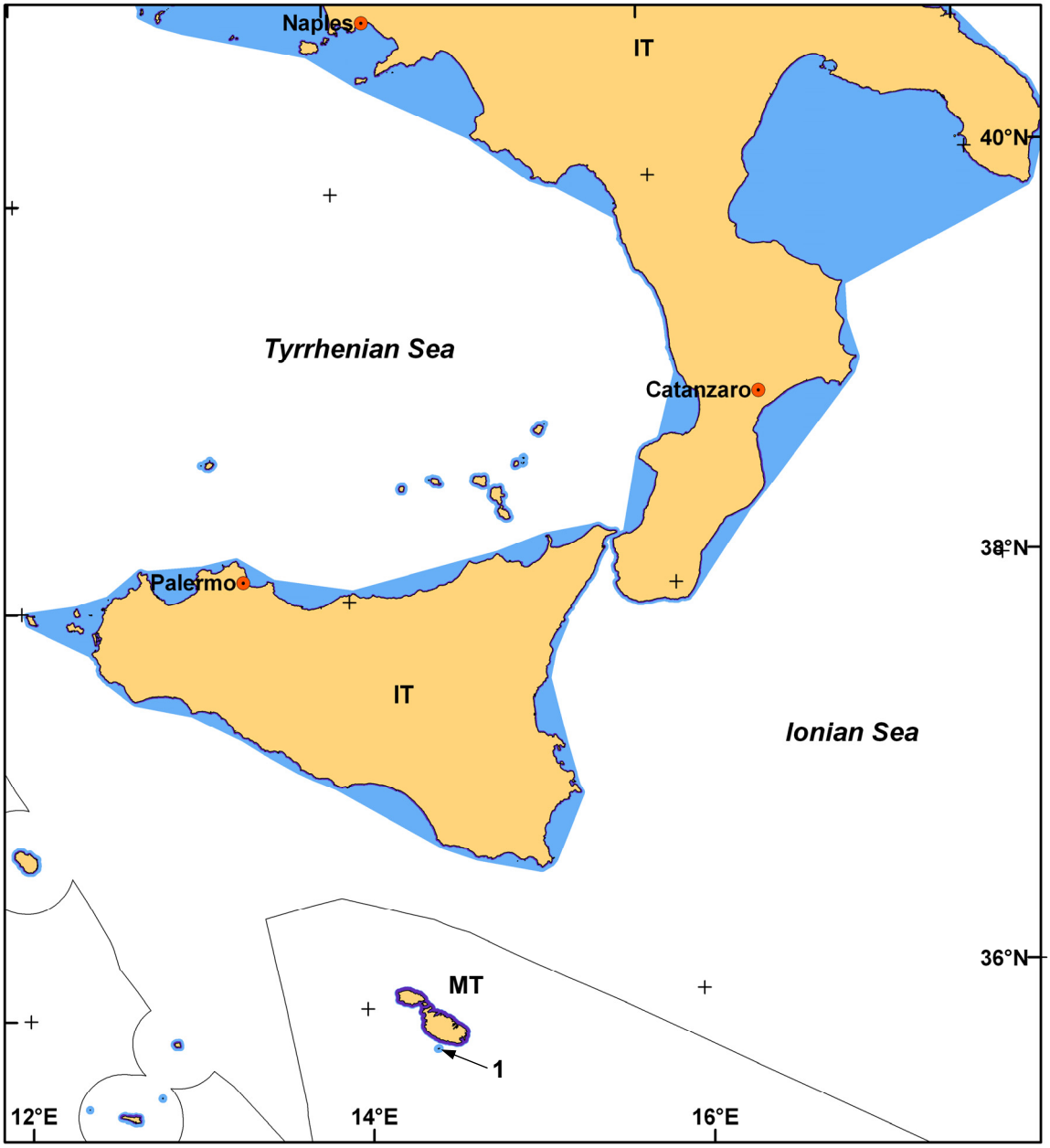

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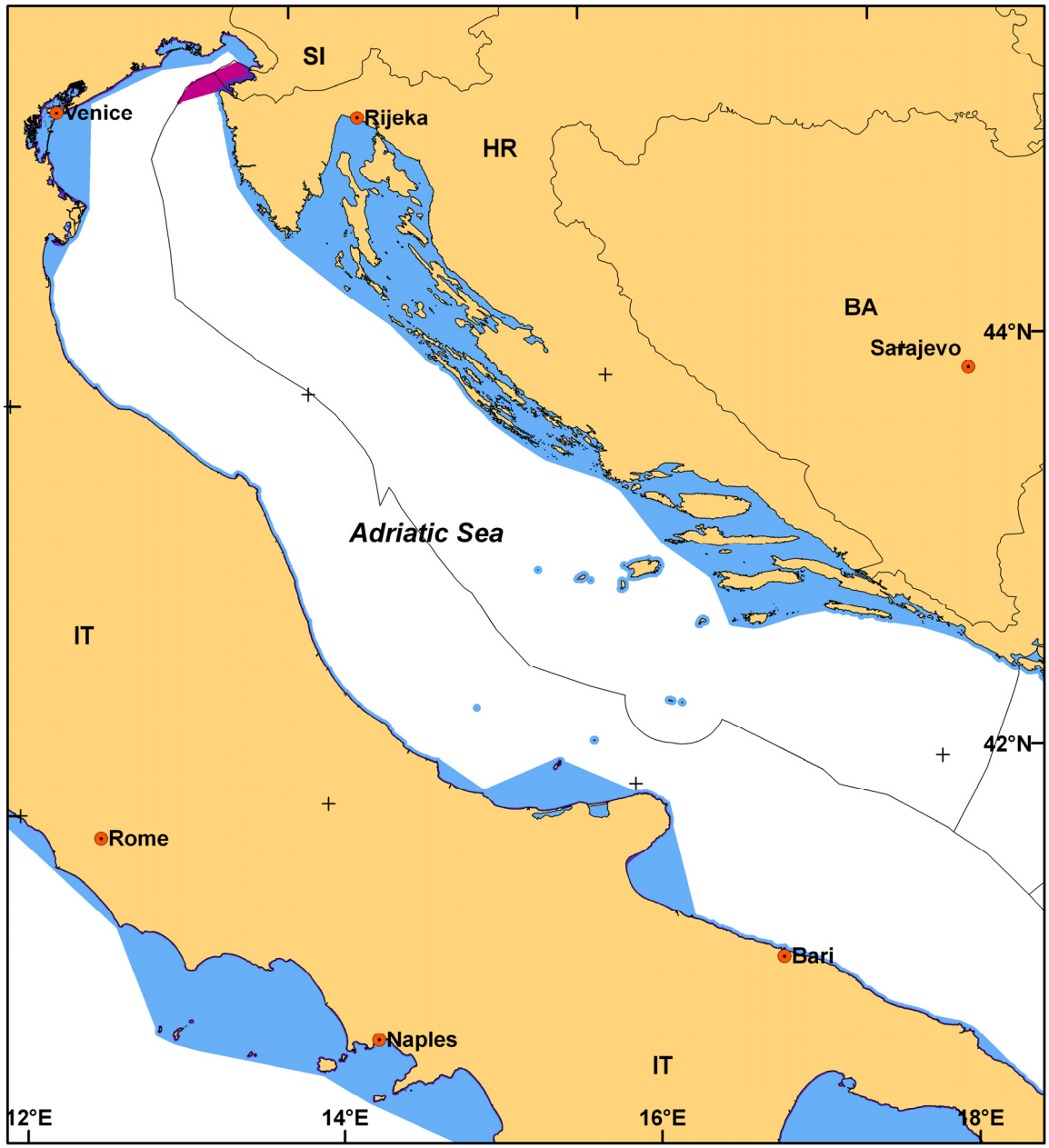
Site mentioned in the text:

1 - Filfla Islet (table 4)



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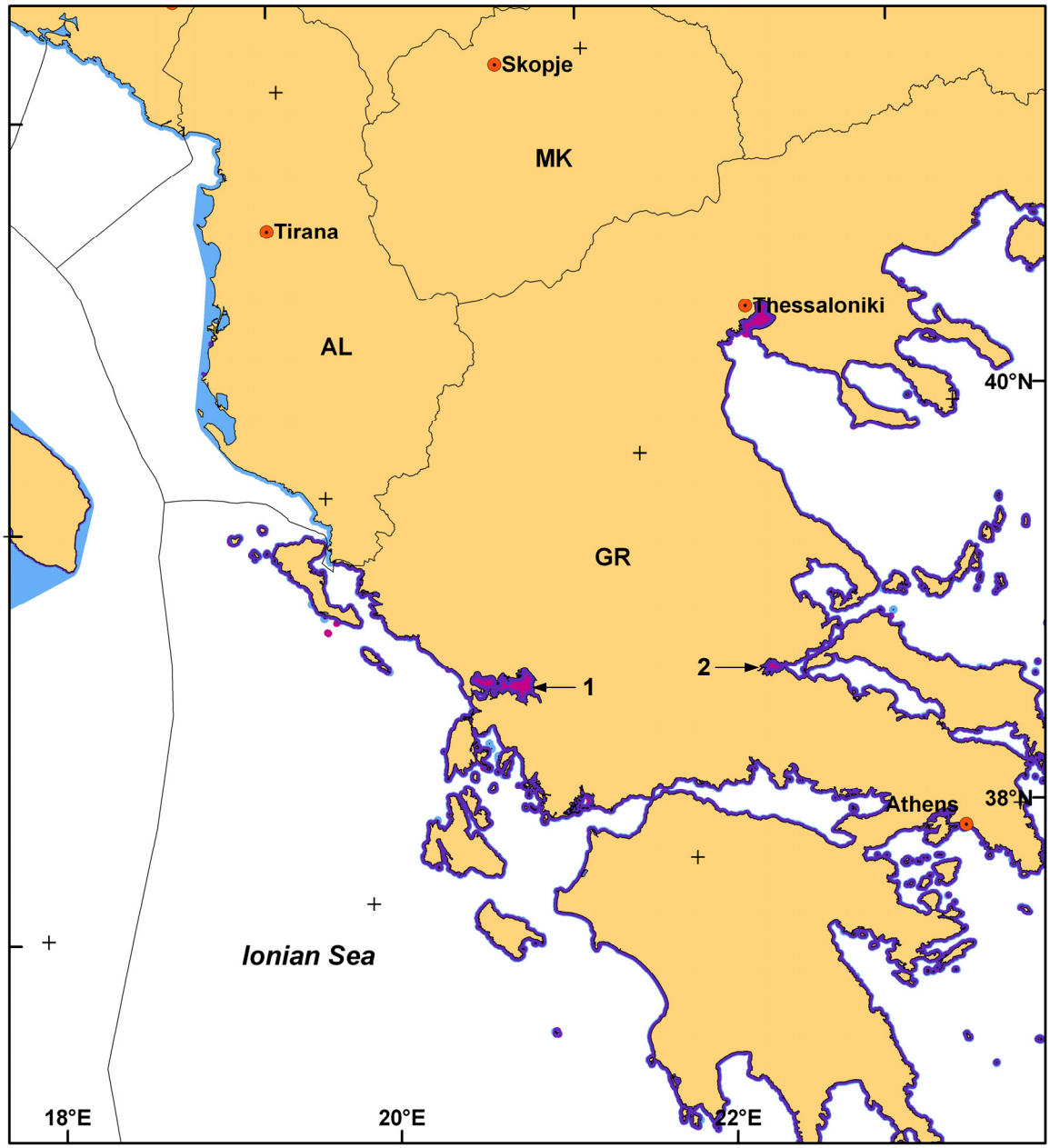

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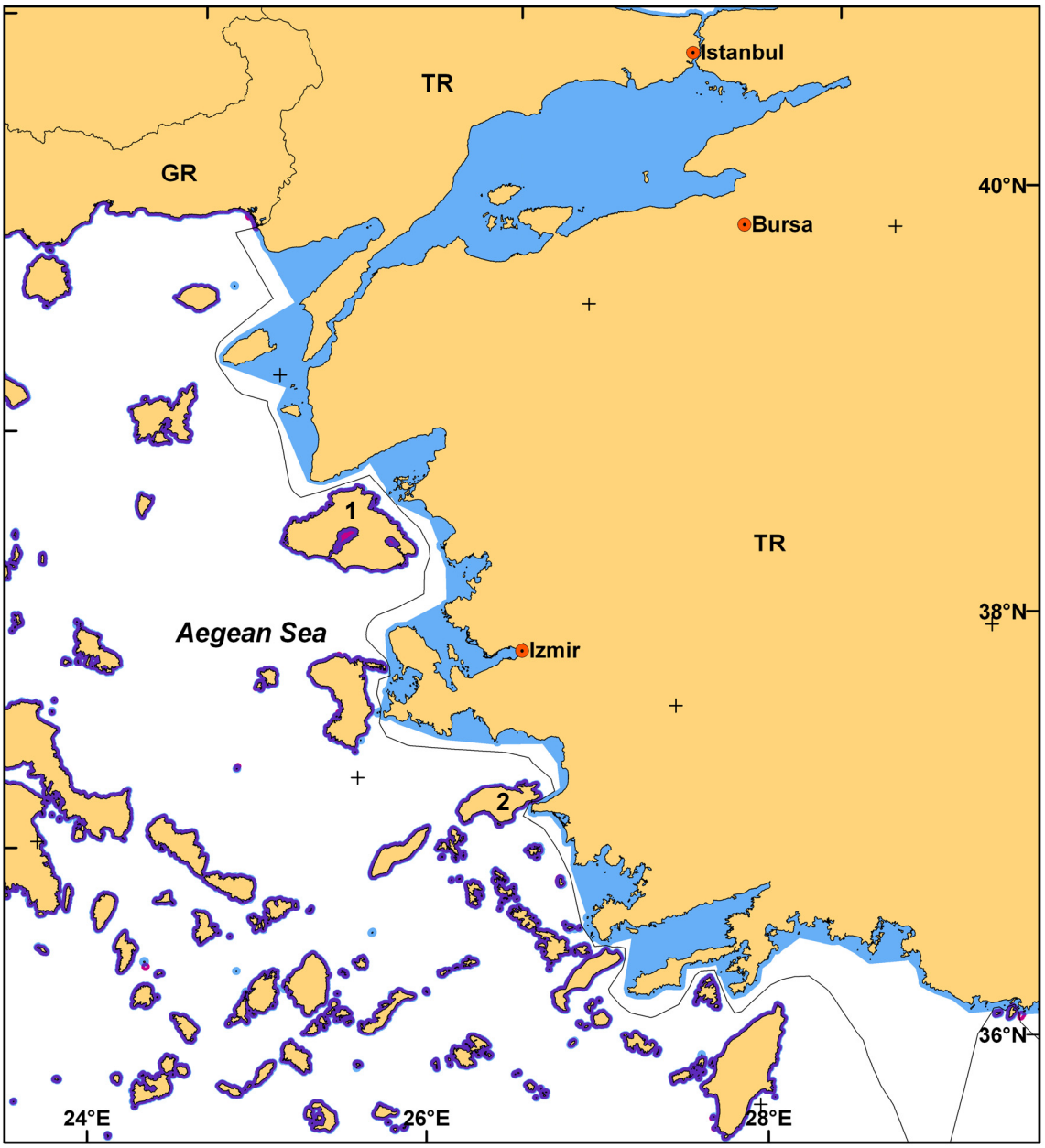
Sites mentioned in the text:

1 - Amvrakikos Gulf (table 4)

2 - Maliakos Gulf (table 4)



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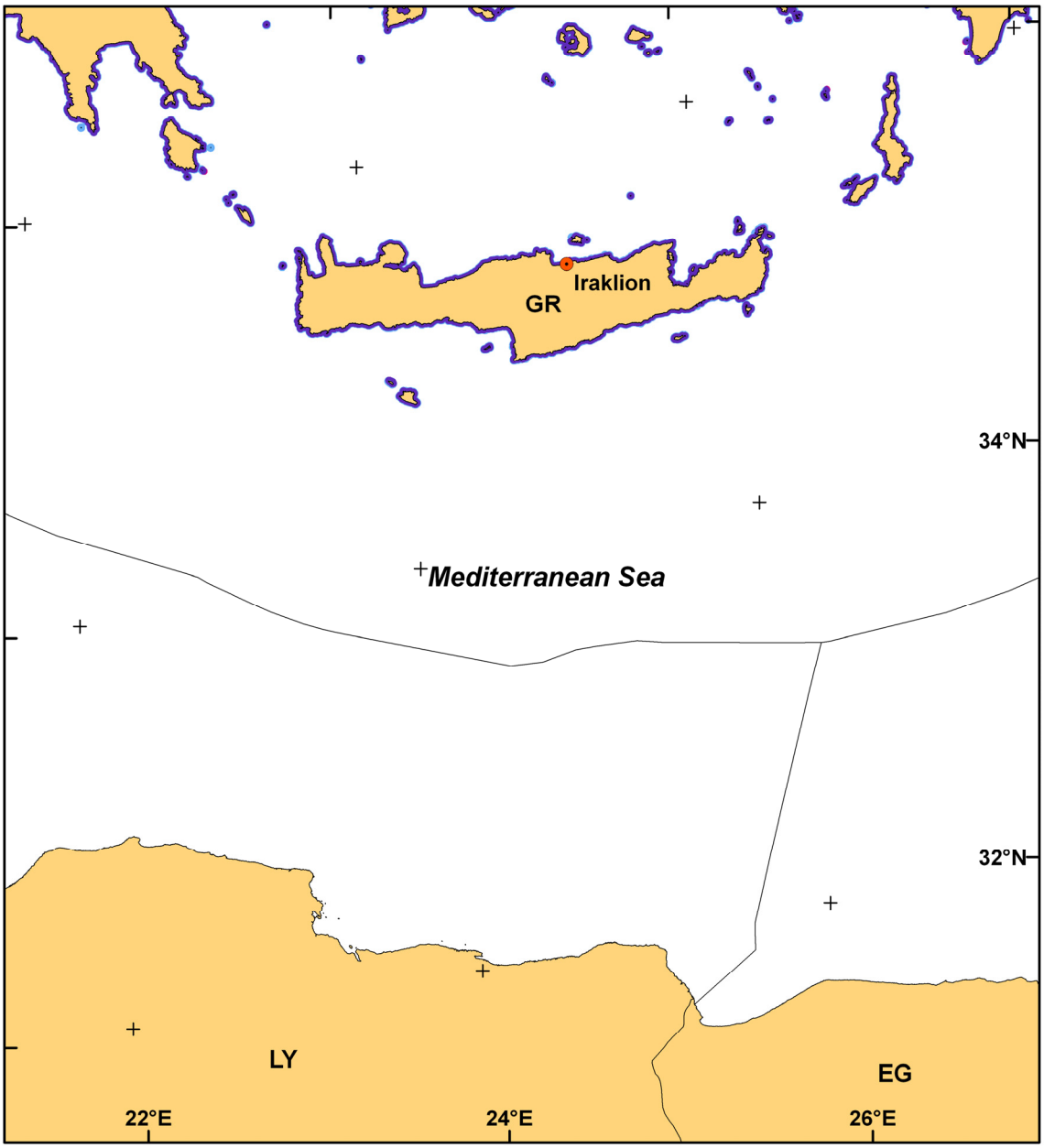
Sites mentioned in the text:

1 - Lesbos Island (table 4)

2 - Samos Island (p. 11)



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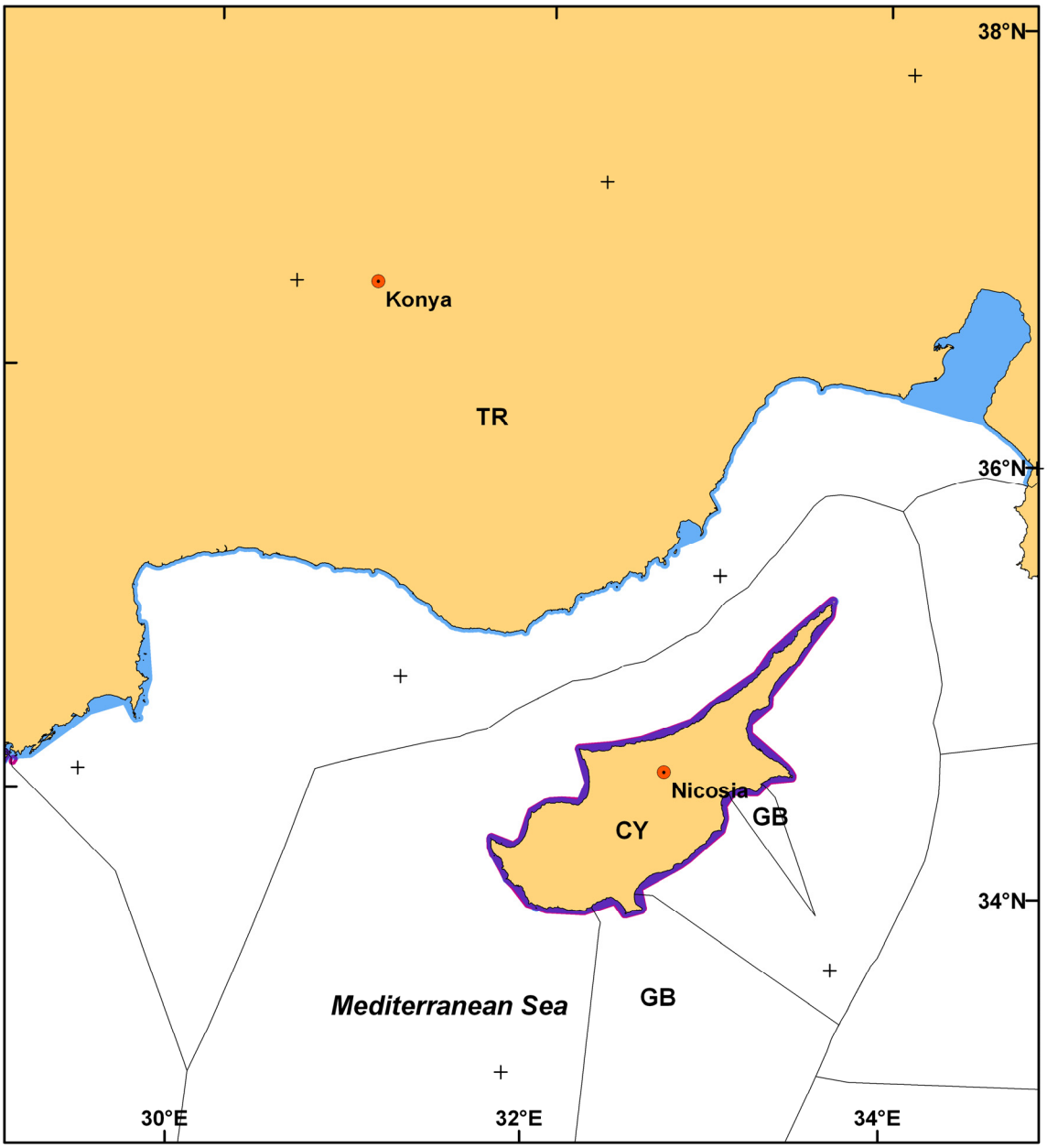

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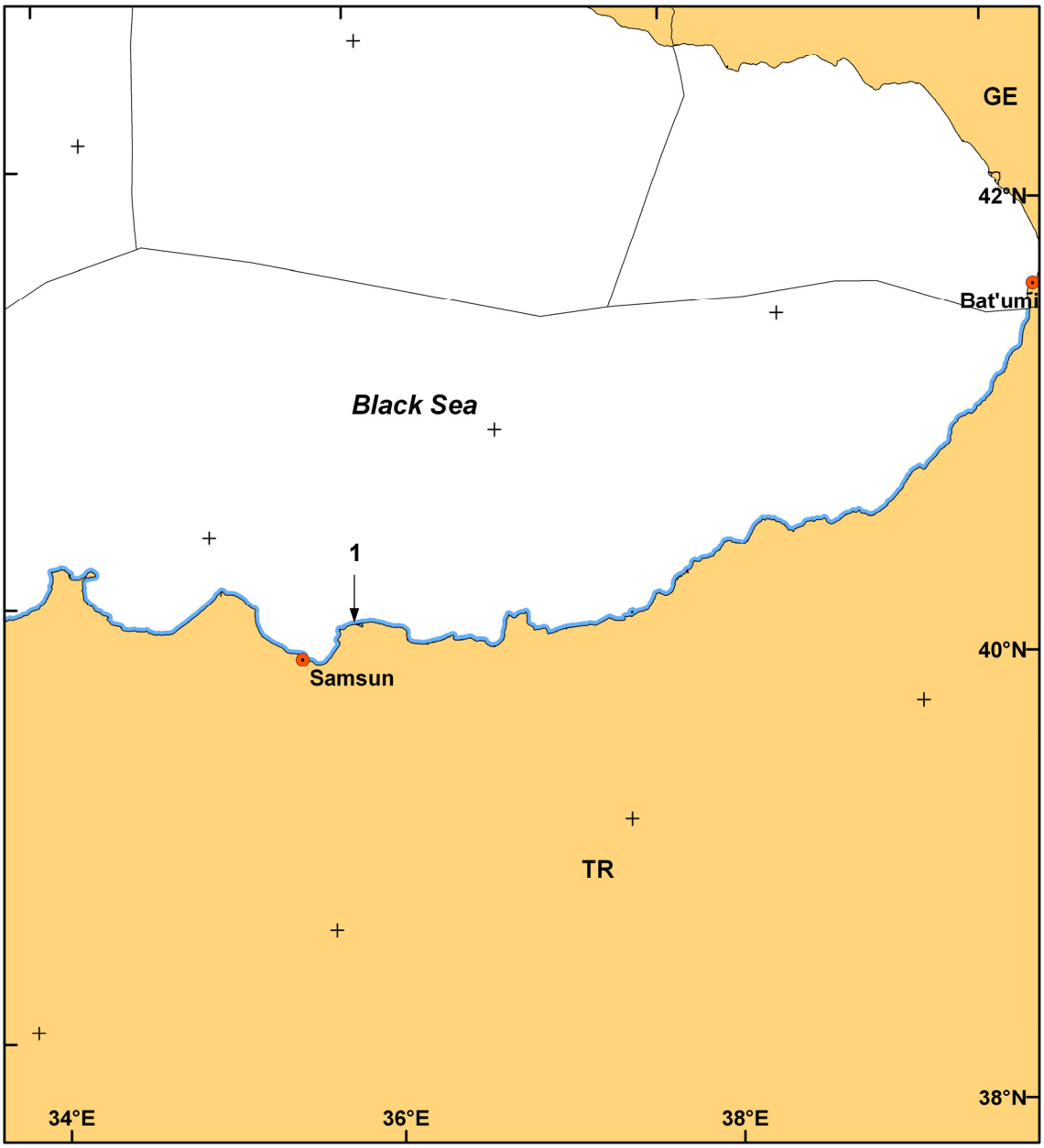

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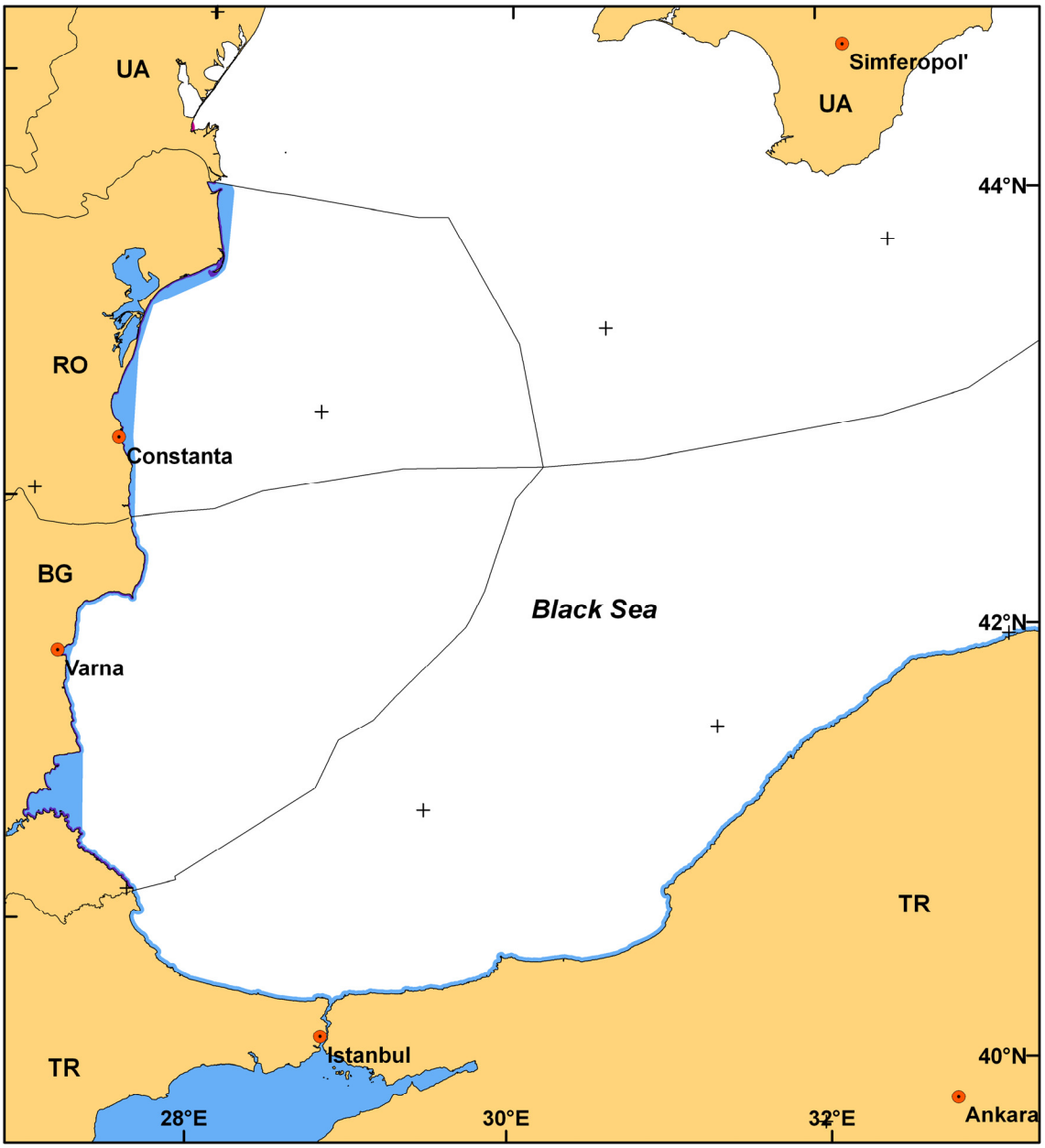
Site mentioned in the text:

1 - Yesilirmak Delta (table 2)



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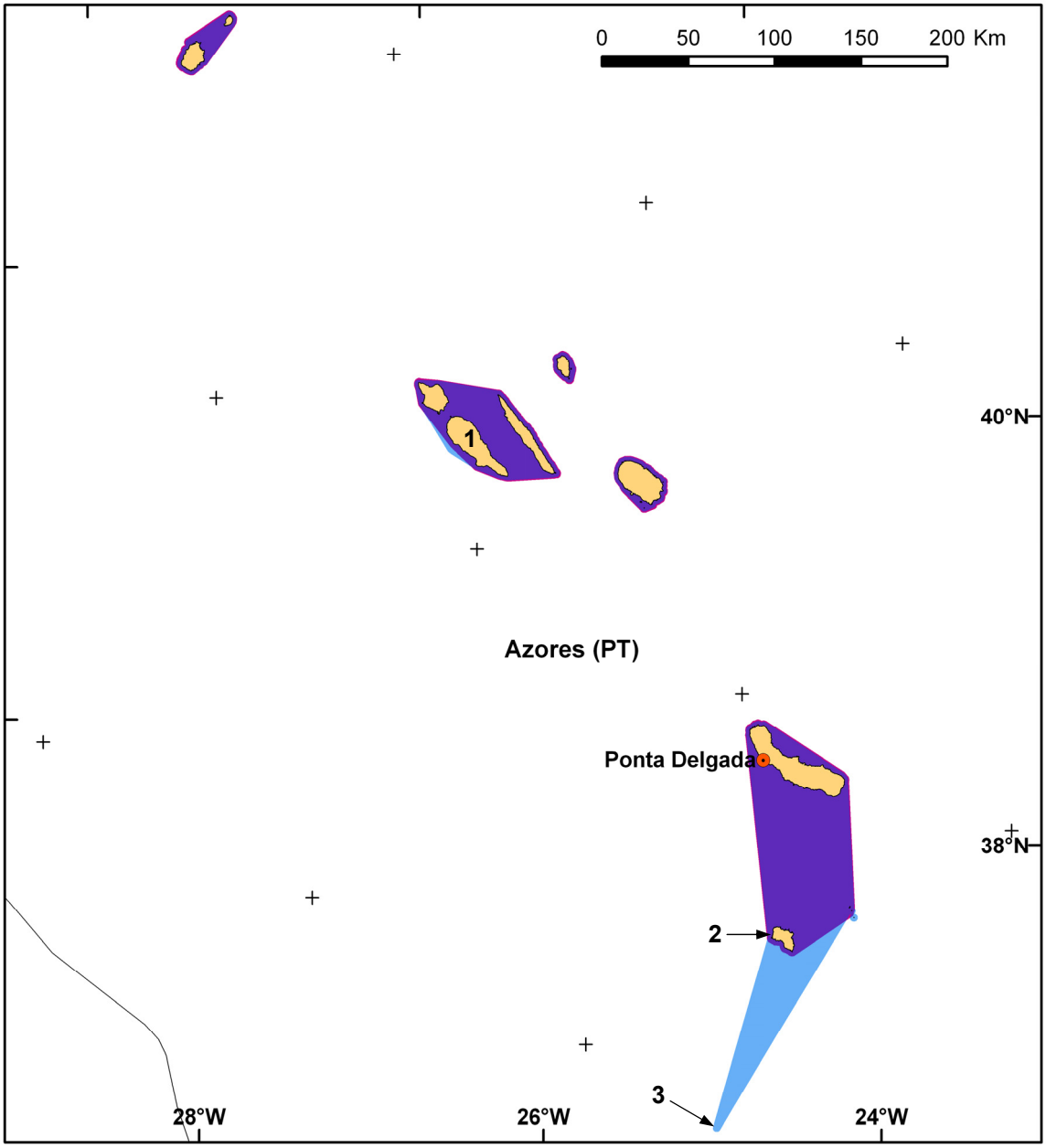

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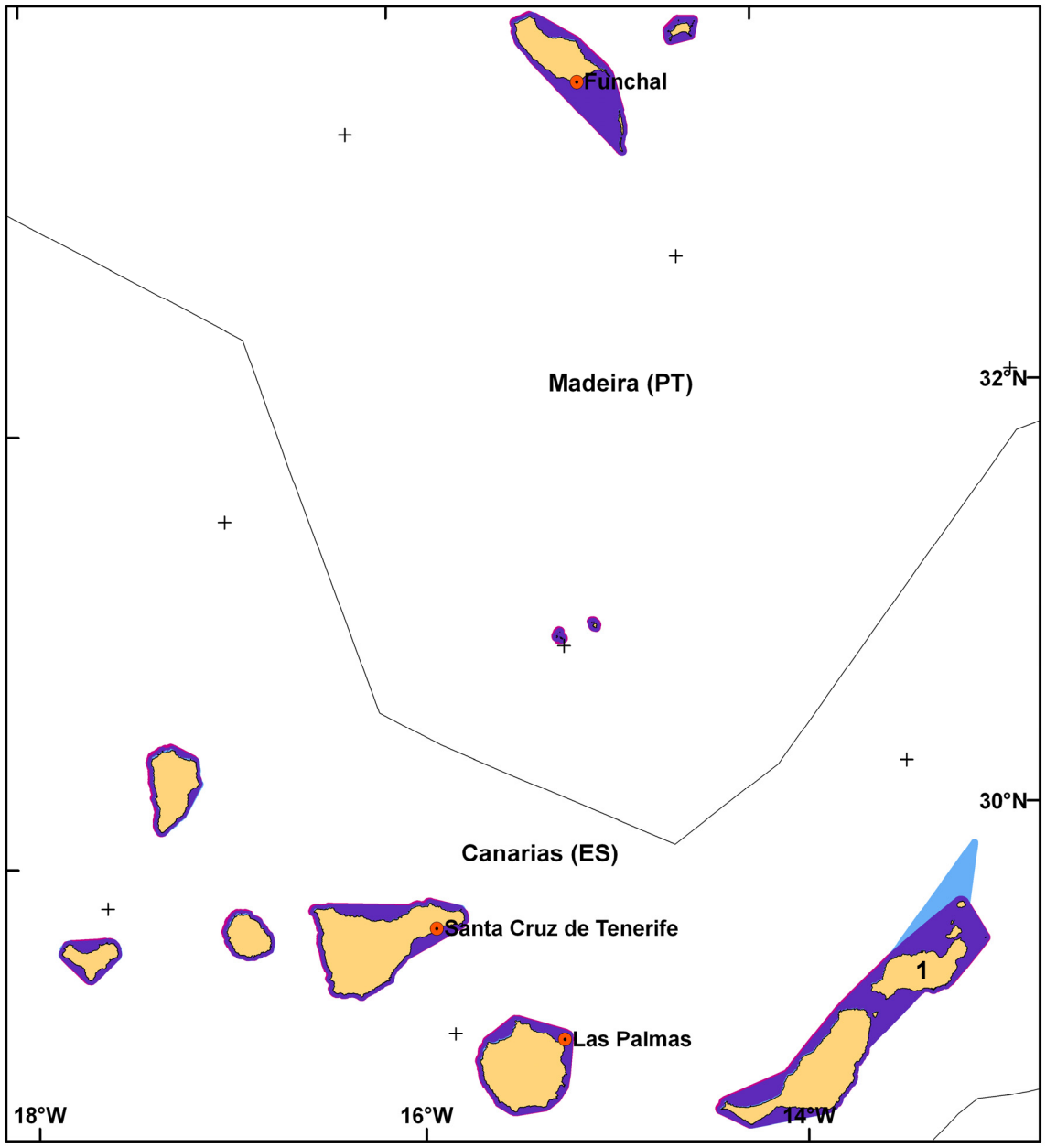
Sites mentioned in the text:

1 - Pico Island (table 4)

2 - Santa Maria Island (table 4)

3 - Sao Gonçalo lighthouse (table 5)



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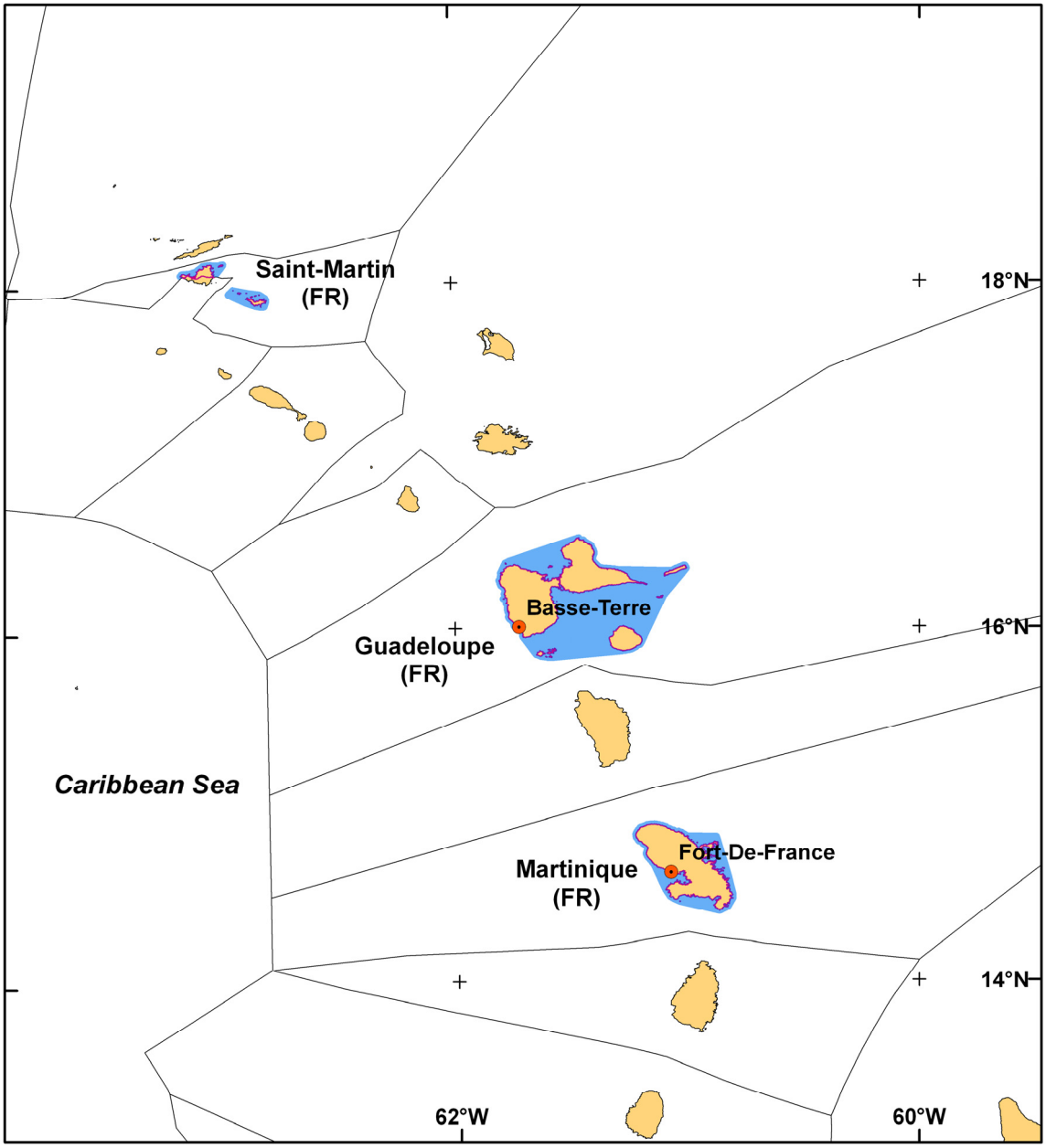
Site mentioned in the text:

1 - Lanzarote (table 4)



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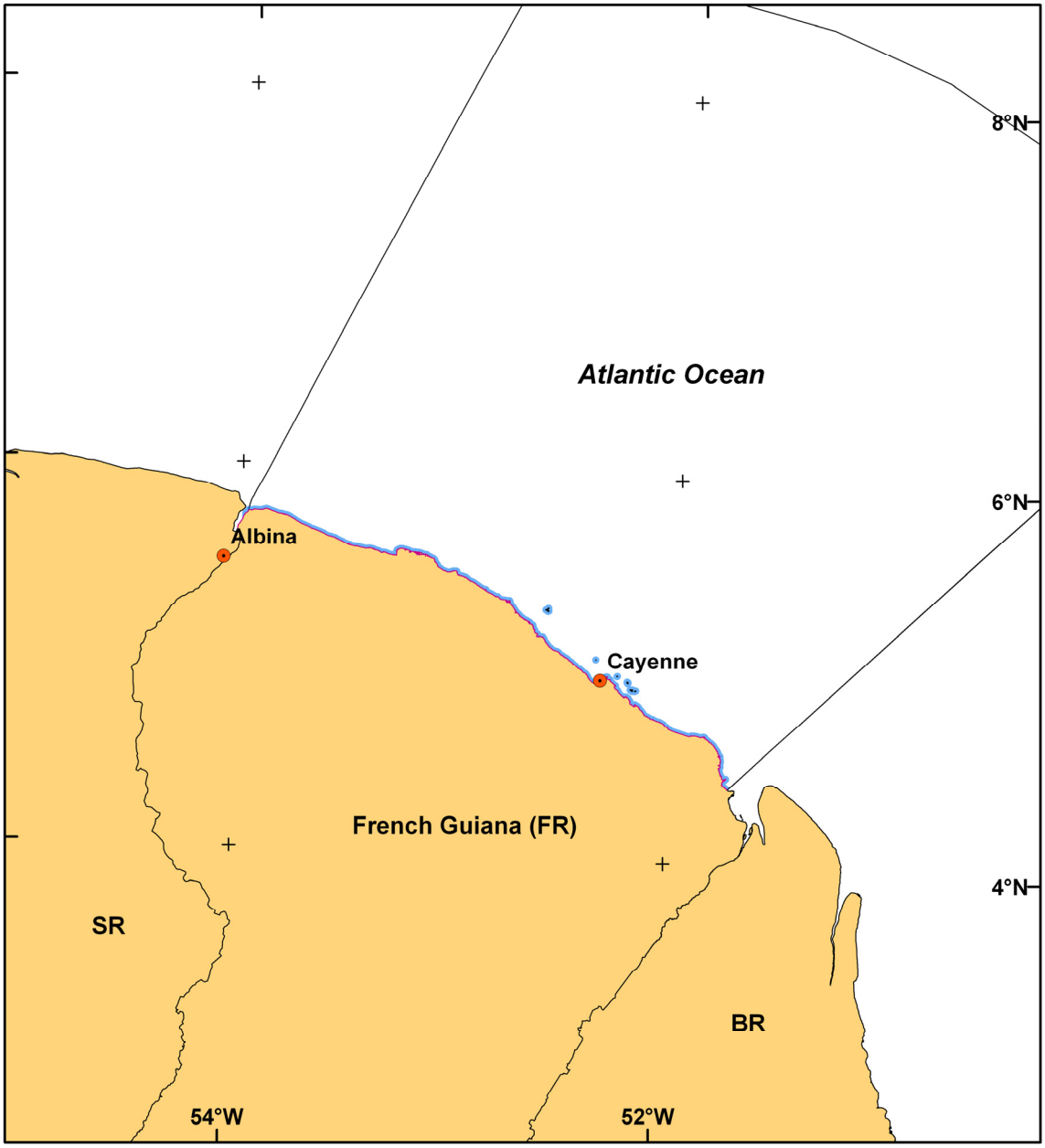

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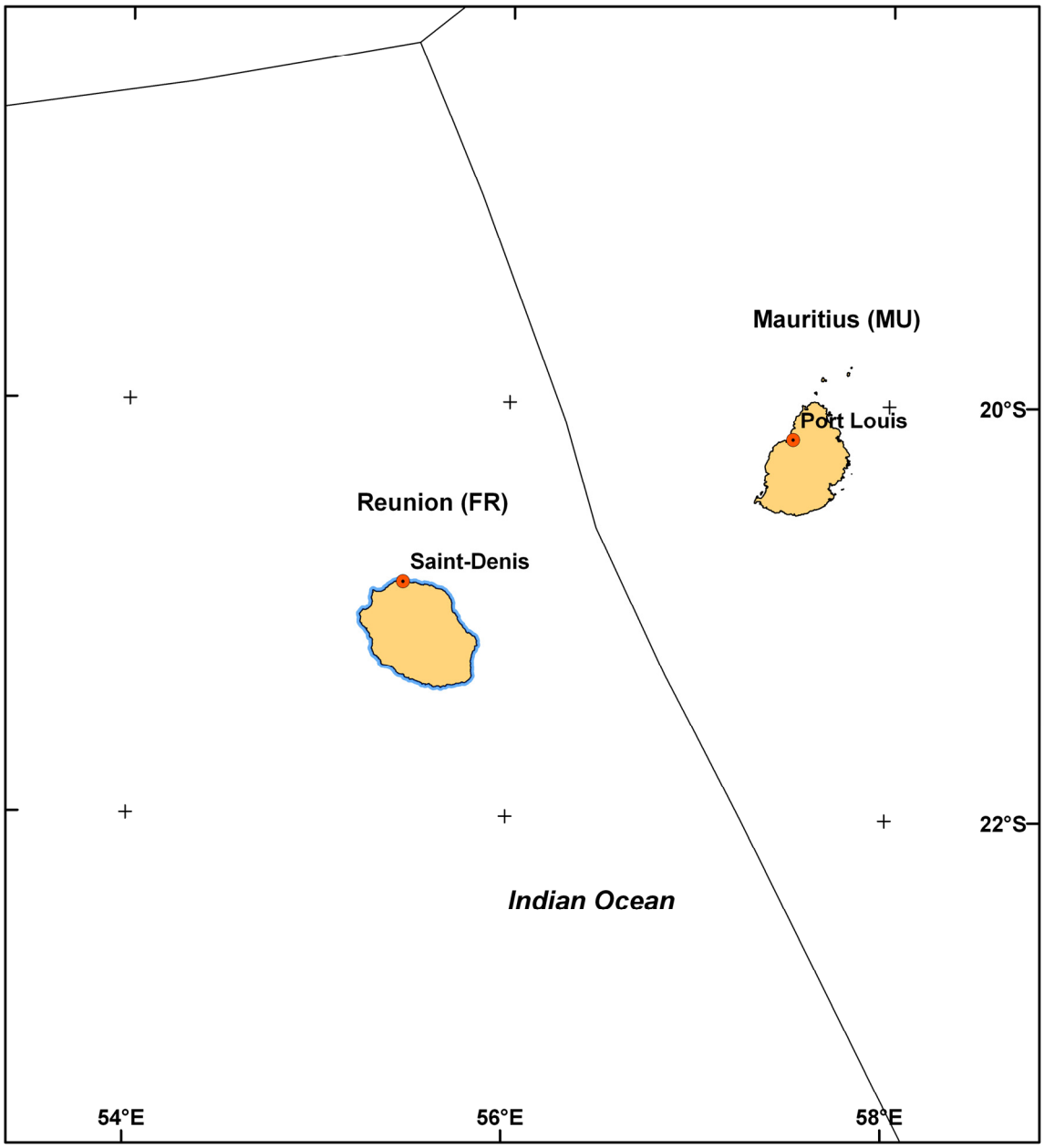

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ANNEX 2

Law Of the Sea documents used to build up the Eurosion baseline (Directorate-General for Environment, 2005).

Country	Laws specifying the position of the baseline	Date
BE	Act concerning the exclusive economic zone of Belgium in the North Sea	22/04/1999
BG	Act of 8 July 1987 governing the ocean space of the People's Republic of Bulgaria	08/07/1987
CY	Geographical coordinates showing baselines for measuring the breath of the territorial sea	01/01/1993
DE	Excerpts from the Regulation on Order in the Frontier Areas and Territorial Waters and EEZ of the German Republic	15/06/1990
DK	Executive Order No. 242 april 1999	21/04/1999
DK	Ordinance No. 599 of 21 December 1976 on the Delimitation of the Territorial sea around the Faroe Islands	21/12/1976
EE	Law on the boundaries of the maritime tract, 10 March 1993	10/03/1993
ES	Royal Decree No. 2510/1977 of 5 August 1977	05/08/1977
FI	Act on the Limits of the Territorial Waters of Finland	09/08/1995
FR	Decree of 19 October 1967 defining the straight baselines and the lines enclosing bays used in determining the baselines from which the breadth of the territorial waters is measured	19/10/1967
GB	Isle of Man Baselines (unofficial document)	
GB	Territorial Waters (Amendment) Order in Council 1979, 23 May 1979	23/05/1979
GR	Law establishing the base lines of the Hellenic Republic	17/09/1936
IE	Maritime Jurisdiction Act, (Straight Baselines) Order, 1959	01/01/1959
IT	Decree of the President of the Republic No. 816 of 26 April 1977 containing regulations concerning the application of Law No. 1658 of 8 December 1961 authorizing accession to the Convention on the Territorial Sea and the Contiguous Zone, adopted at Geneva on 29 April 1958, and giving effect to that Convention	26/04/1977
LT	Law of the Republic of Lithuania on the State Boundary of the Republic of Lithuania	01/01/1992
LV	Law of the Republic of Latvia "On the Border of the Republic of Latvia"	01/01/1990
MA	Decree No. 2.75.311 of 11 Rajab 1395 (21 July 1975) defining the Closing Lines of Bays on the Coasts of Morocco and the Geographical Co-ordinates of the Limit of Territorial Waters and the Exclusive Fishing Zone	21/07/1975
MT	Territorial Waters and Contiguous Zone Act, No. XXXII of 1971, as amended by the Territorial Waters and Contiguous Zone (Amendment) Act 1975, the Territorial Waters and Contiguous Zone (Amendment) Act 1978 and the Territorial Waters and Contiguous Zone (Amendment) Act 1981	01/01/1981
NL	Netherlands Territorial Sea (Demarcation) Act of 9 January 1985	09/01/1985
PL	Act concerning the maritime areas of the Polish Republic and the marine administration, 21 March 1991	21/03/1991
PT	Decree-Law No. 495/85 of 29 November 1985	29/11/1985
RO	Act concerning the Legal Regime of the Internal Waters, the Territorial Sea and the Contiguous Zone of Romania, 7 August 1990	07/08/1990
SE	Royal Notice No. 375 of 3 June 1966 containing Regulations on the Measurement of the Territorial Waters of Sweden	03/06/1966
TR	Limits in the seas n°32 - straight baselines : Turkey, May 15, 1964	15/05/1964

European Commission

EUR 24654 EN – Joint Research Centre – Institute for Environment and Sustainability
Title: A pan-European delimitation of coastal waters: Compliance with EU environmental legislation.
Authors: Camino Liquete, Francesca Somma, Joachim Maes
Luxembourg: Publications Office of the European Union
2010 – 60 pp. – 21 x 29.7 cm
EUR – Scientific and Technical Research series – ISSN 1831-9424
ISBN 978-92-79-18907-4
doi:10.2788/71030

Abstract

The definition of coastal waters in relation to EU environmental legislation was clearly stated in the Water Framework Directive. In compliance with this Directive, most of the EU Member States delineated their coastal waters' boundaries. However, these delineations are not as complete and homogeneous as could be expected. A clear identification of European coastal waters boundaries is crucial for the implementation of the Water Framework Directive and the Marine Strategy Framework Directive, which depend on an accurate ecological/environmental assessment of those waters. Hence, there is a need for a comprehensive and unambiguous delimitation of European coastal waters.

This report aims at bridging this gap providing a pan-European mapping of coastal waters, which cover 553,817 km^2 in 30 seaside countries, 340,524 km^2 of which pertain to the 22 EU Member States connected to the sea. For this purpose, a comprehensive geographical analysis of the national baselines and transitional waters distribution was performed. A pan-European baseline of 63,340 km was delineated as a basis for the European coastal waters delimitation.

The European coastal waters identified in this work show significant differences with the available national declarations (almost 12% of the compared area), the latter defining an additional area of 29,337 km^2 with respect to the former. The largest deviations seem to be due to misinterpretations of the definition of coastal waters in the Water Framework Directive, although a number of one-sided national modifications to that definition are also observed. This work provides the geographical basis for a full consultation process and discussion about this subject.

Our recommendations include setting a clear geographical limit between the Water Framework Directive and the Marine Strategy Framework Directive jurisdiction, revise the possible exemptions in the definition of coastal waters, and discuss their consequences in the assessment of ecological/environmental status.

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